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Young Chemists and Reserved Occupations

DR. LEVINSTEIN'S letter to *The Times* on the subject of the inclusion of chemists of the age of 21 in reserved occupations has aroused a great deal of interest. Of the writers upon the subject in our correspondence columns during the past two weeks, Mr. Kenneth Chance and Dr. Varges Eyre agree with Dr. Levinstein's view, primarily on the ground that young men of the age of 21 who have only just graduated, perhaps with honours, in chemistry and are entering industry, cannot consider themselves chemists and should not therefore be exempt. Dr. E. F. Armstrong agrees in principle with Dr. Levinstein's views and brings in the question of exemption from the Conscription Act, which applies to everyone irrespective of occupation before the age of 21 is attained. Parenthetically, it does seem foolish to waste the nation's resources in training young men of 20 in the Army if at 21 they are to be promptly put into reserved occupations and forbidden to serve with the forces.

The contrary view is taken by Sir Robert Robinson on the ground that it is not a matter of *indispensability* but of putting every man into the place in which he can be of the maximum use and that even the young chemist, to whom some of our leaders would deny even the right to call himself a chemist although fully trained academically, would be of more value in his civil employment than in the firing line. This view is shared by Mr. W. A. S. Calder and by Mr. Thomas Durrans, the latter on the ground that six months training will make these young chemists of far greater value to the community as chemists than as professional soldiers. Opinions therefore seem to be evenly divided and largely to cancel one another out.

The opinion has been expressed that the young men themselves do not desire to be exempted and from their point of view there is much truth in this. Not everyone is fitted to be a soldier and by ruthlessly conscripting every medically fit young man, regardless of his mental make-up, we may be actually weakening our fighting force. That, however, would probably not affect this present problem because the chemist is surely well fitted mentally to become a soldier, and on that ground most chemists might well be found to be extremely suitable for the firing line either directly or in the Chemical Corps. A Chemical Corps would be needed for a variety of uses, even if it be only to test the fitness of waters, foods, and other materials used by the troops at the front, and to contend with gas attacks and their results and devise retaliation. The fit young chemist, the mentally and physically A1 man, may thus very well find his niche in the fighting forces here, and in view of the needs of the service for a Chemical Corps it seems foolish to put these men directly in the rank and file of the fighting troops; they are the raw material for a specialist corps, and should be so employed, if they desire.

> *. . . I envisage an enlargement of the functions of the gas industry which will bring it more into the chemical field. Even if this is delayed and the chemical operations are performed and the profits taken by others, there is none the less the necessity for the industry to be chemically minded to a greater extent than it is at present if it is to keep abreast of the times.*
>
> —*E. F. Armstrong.*

But it should not be forgotten also that the ideal of service is that every man should be in his right place. These young, academically trained chemists are the most valuable raw material and six months good works training would perform wonders on them. There is the example of a chemist—not an honours graduate either—who at 23 successfully managed a munition works in the last war; would he have been better as a private in an infantry regiment? The result of a future war may not necessarily turn on putting masses of men in the field, but by the nation that is best equipped industrially. Fresh recruits will be needed for the industrial army; are not these young men the finest raw material to fill the gaps that war and nature leave in industry? Enlistment at 21 will at once cut off further supplies at their source. A long war must be visualised and our resources planned accordingly.

It has been pointed out by *The Times* that indiscriminate enlistments weakened the nation's effort in 1914 and that skilled men had to be brought back from the Front, but not before in one short year the chemical and explosives industry had lost 23.8 per cent. of their employees. These indispensable industries will need to be expanded in time of war, and we must retain sufficient raw material for that expansion. Even though the new graduate may be rated no higher than the rawest of raw material, he is still raw material of which we shall have abundant need before another war, should one ever arise, would be lost and won. A further factor which is deserving of consideration is the re-establishment of the industry following a future war. This may seem to be looking too far ahead but it is nevertheless a point to be considered. The young chemist of to-day is the corner-stone in any re-building of the industry of to-morrow.

NOTES AND COMMENTS

The S.C.I. Annual Meeting at Exeter

THE main theme of the annual conference of the Society of Chemical Industry which is to be held under the patronage of H.M. the King at the University College of the South West, Exeter, from July 10-15, will be "The Trend of Progress" and the subjects discussed will range from agricultural chemistry, including the latest discoveries in fungicides and insecticides, to oils and soap, cellulose and cosmetics. The conference will be in effect a continuation of the Society's symposium at the Glasgow Exhibition last September when the "Trend of Progress" in the food, road, building, plastics, and chemical engineering industries was discussed. During the meeting, the Society's Medal will be presented to Sir Gilbert T. Morgan. In addition to tours of the cider factories, dairies, and other sections of the agricultural industries of the South Western Counties, conference delegates will pay a visit to Dartington Hall to see the famous series of educational and agricultural experiments which are carried out there. Receptions include one by the civic authorities of Exeter and another by the Principal of University College. The President of the Society, Mr. Victor Bartram, of Canada, will, it is understood, be accompanied by a large party of prominent American and Canadian scientists representing various branches of industry overseas.

Planning Ahead

MR. OLIVER STANLEY, the President of the Board of Trade, gave some extremely sensible advice to all and sundry in a speech at Kendal last week-end. After defining the position in which we were now living as a war of nerves, he declared that there was nothing more dangerous than the tendency to sit down and say: "What is the good of planning? What is the good of buying this or that? Where shall I be in a year's time?" He condemned that attitude as worse than disastrous; it was stupid. If a great catastrophe arose, a man would not be better off because he had not papered his room or bought a new car. Adherence to such a tendency, on the contrary, would weaken the whole economic structure, and make us less ready to meet peril if it came. His concluding words might well be framed and hung up by every business man in a prominent position: "Let us give to the State whatever the State asks, and then let us go on with our ordinary lives, planning ahead, knowing that by doing so we are rendering the best help we can to the economic structure of our lives."

Big Decrease in German Dye Exports

ACCORDING to a report from the American Consulate General, Frankfort-on-Main, German dye exports fell off heavily in 1938, dropping by about 11,000 metric tons in volume and 37,000,000 marks in value to a total of 27,505 tons valued at 109,116,000 marks. This is by far the lowest value of any year in the last ten or fifteen years. Although an upward trend in the export trade was recorded in the first two months of 1939, the improvement was limited in comparison with the heavy losses in 1938, and the total value of the outgoing trade continued considerably below levels of the corresponding months of 1937. Assuming that consumption of dyestuffs in Germany itself was not considerably greater in 1938 than in 1937 and having in view the severe drop of exports by about 11,000 metric tons, it would appear that Germany's total trade in dyestuffs (domestic and foreign trade combined, but excluding deliveries by the formerly Czecho-Slovak controlled plants) amounted to roughly about 63,000 metric tons. Many foreign markets decreased their purchases of German dyestuffs in 1938 and in the majority of cases the decreases were substantial. The heaviest losses, however, occurred in the Far Eastern markets and these collectively accounted to a considerable degree for the total losses of German trade. European markets also in general recorded markedly smaller purchases, this applying especially to Great Britain, Italy, Netherlands, Scandinavia and Spain.

New Textile Fibres

LAST week's conference of the Textile Institute at Bath gave a very good impression of the trend of development in the new artificial textile materials. While, of course, these materials are in competition with existing fibres, the competition cannot be said to be direct as the new materials have radically different chemical and physical properties which can be utilised for producing novel decorative effects. New fibres can be produced either by working up a material entirely new to the textile industry (as in the case of nylon) or by subjecting an already known artificial fibre to certain chemical and physical treatments, applied either during or subsequent to the actual process of producing the fibre. It appears from the papers read at the Textile Institute Conference that the latter type of development is the one in which the most progress is being made at present. For example, Rayolanda X and Rayolanda W.D. are produced by a chemical modification of viscose by Courtaulds, Ltd.; both fibres have wool-dyeing properties and possess a warm, soft, woolly handle. According to Mr. H. A. Thomas, they "have struck a new note in textile design and construction." Teca is the name of a type of cellulose acetate staple fibre manufactured by the Tennessee Eastman Corporation. Here again, while the process of manufacture is essentially similar to that of continuous filament cellulose acetate, a modification has been introduced to give the product a crimp form with the number of crimps per inch averaging from 8 to 12. This crimp is said to be not merely imposed on a fibre structure whose inner stresses are tending to straighten the fibre again, but it is the inherent stable form of the fibre substance. A new class of high tenacity yarns is made by Courtaulds, Ltd., and called Tenasco, by a modification of the ordinary viscose spinning process. The increase in tenacity is obtained by applying a stretch to the filaments, the conditions of stretch spinning being chosen so as to yield a dry tenacity considerably higher than normal, with an extensibility which can be suited to the purpose for which it is required.

Creative Ability in Industry

ENCOURAGING advice to younger men in business is offered by Mr. Peter Bennett, president of the F.B.I., in the current issue of *British Industries*. Although, he says, times have changed since he started in a small way on his own account, and modern business is organised in larger units, "the men who are alive to take advantage of opportunities, and are willing to work hard and are not in too much hurry, will eventually succeed." Between the "joints" of the big organisations, Mr. Bennett says that there are still openings for men who can start off on lines of their own—men who can concentrate on some particular article which lends itself to specialised treatment or who can develop something new. Creative

ability is wanted in every department of industry, though it is vitally important that young men should be thoroughly trained in fundamentals. "After that, they should be encouraged to think out their problems—and not take everything for granted. We need men who have the courage to break with old ideas when such ideas are hindering progress. One of the dangers in a business which has a run of success is complacency, and so I like to see young men lively in mind and refusing to be tied to the past when present conditions demand a change." In a word of advice to those who are assuming high positions in business, Mr. Bennett emphasises the value of deputising work. "Many men never make the progress they ought, or could, because they insist on carrying out every detail themselves for fear that other people wouldn't do it as well. I have found that if people are left alone to get on with it, they do better work and thrive on responsibility, provided, of course, you have chosen the right men."

Rayon and the Cotton Industry Bill

COURTAULDS, LTD., and British Celanese, Ltd., issued a joint statement on Monday reiterating their opposition to the Cotton Bill. The statement explains that rayon and cotton are competitive rather than complementary, and produces statistics to demonstrate the fact clearly. The companies point out that they are not opposing the Cotton Bill or the reorganisation of the cotton industry, but they consider it essential that the rayon industry be permitted to control its own destinies and that as part and parcel of the Bill a Rayon Industry Committee should be set up under Clause 15. Clause 15 provides that if the Cotton Industry Advisory Committee is satisfied that representatives of rayon fibre manufacturers, fabric weavers, finishers and merchants desire the constitution of a representative committee it may make a recommendation to the Board of Trade. An advertisement in the daily Press on Tuesday issued by the Rayon Producers' Group of the Rayon and Silk Association sets out reasons why the Rayon Industry Committee should be established *now*. This, the advertisement states, would mean that the Cotton Industry Board would concern itself primarily with cotton and the Rayon Industry Committee would watch over the general interests of rayon. The latter body would co-ordinate sectional (e.g., dyeing and weaving) rayon schemes before reporting on them to the Cotton Industry Board.

Export Trade Methods

A CORRESPONDENT to the *Daily Telegraph and Morning Post* throws out some useful hints on export trade methods as a result of a business trip to Switzerland. Switzerland needs foreign goods, he points out, and in the past has bought much from Germany, but now finds quality deteriorating, deliveries delayed, and difficulties in the collecting of payment. He asserts that Switzerland as well as other countries, would like to increase her trade with Britain, but difficulties stand in the way. He cites these as: "An English firm will seldom quote in Continental measures or sizes, but German firms will quote to customers in England in inches. English machines are old-fashioned compared with the up-to-date German ones. Prices are often 30 per cent. higher, and correspondence is seldom conducted in German or French. Advertisements and folders are printed in English only. The Germans print them in every language. Delivery from English firms is f.o.b. The Germans deliver free to the Swiss frontier."

Chemicals in Industry

Organisation to Study and Treat Peculiar Vocational Diseases Suggested

A SUGGESTION that, on account of the greater use of chemicals in industry, there should be a careful study of other diseases than are scheduled under the Act, was made by Sir Arnold Wilson, M.P., when he gave evidence before the Royal Commission on Workmen's Compensation, at Thames House, Millbank, London, S.W.1, Sir Hector Hetherington presiding. Sir Arnold presented a lengthy memorandum, compiled in collaboration with Professor Hermann Levy, in which he advocated that workmen's compensation insurance should be compulsory, under a Workmen's Compensation Commissioner and a State Insurance Office, and that basic premiums be collected with the N.H.I. contributions, by means of stamps to be affixed by the employers, and to the cost of which the workers should contribute from ½d. to 1½d. per week. He further advocated the re-organisation and extension of mutual indemnity associations, to cover all public utility companies, public local authorities and Government Departments, and all important industries, and upon which the employers and the workers should be jointly represented.

Industrial Diseases

With particular reference to industrial diseases, Sir Arnold stated that the creation of mutual indemnity associations, under a Commissioner for Workmen's Compensation, and with compulsory administrative powers, would greatly facilitate the study and treatment of these peculiar vocational diseases, the effects of which were not fully known, as was shown by the occasional and unexpected occurrence of fatalities.

Sir Arnold drew attention to the last annual report of the Industrial Health Research Board, in which specific mention was made, amongst other things, to industrial solvents and their toxicity. Volatile organic substances, he stated, were used with increasing frequency in many industrial processes and new compounds which might involve new risks for the worker were coming into use.

"An organisation on the lines of indemnity associations, grouped by industries and trades, not restricted to the mere question of compensation insurances, but ready to devote some of their energies to accident prevention and kindred matters," suggested Sir Arnold, "could usefully collect material amongst their members in respect of such diseases, and suggest appropriate means of prevention."

An Example from the Mining Industry

Sir Arnold instanced the work of the Miners' Welfare Fund, which was administered by representatives alike of masters and men, with its own medical experts, and suggested a development of this sort of organisation. The mutual indemnity associations, he made it clear, would be "contracting out" of the Act, on the understanding that the benefits they gave were at least as large as the minimum required by the existing law, including full medical treatment and vocational, as well as medical, rehabilitation, free of cost to the workmen. Sir Arnold said he had been impressed with the present absence of any system of social and vocational rehabilitation, and he also regarded the present scales of weekly payments as inadequate, even when considered in relation to sickness benefits.

WITH a view to reducing Germany's consumption of borax and thus its outlays in foreign exchange required for supplies of this material, the Reichs Trade Control Board for Chemicals has placed restrictions upon the use of boron materials, including calcium borate, boron mineral, boric acid, and borax in the manufacture of leather, finishing agents used by the leather goods and hat industries cosmetics, office glue and light construction boards as well as in the processing of casein and shellac. Nearly all Germany's national requirements of boron materials are imported.

Crude Rubber Control in Manufacturing Processes

By
T. L. GARNER, M.Sc., F.I.R.I.

PRACTICALLY all the raw rubber used in industry to-day comes from plantations in the form of smoked sheets or pale crepe. Formerly Para rubber was accounted the finest obtainable, but to-day the best rubber is that from the planations and the Para rubber available is very much inferior to that which could be obtained some years ago. Wild rubbers, other than Para, are of poor type and only used in very small quantities, and it may be accepted that practically all the rubber used in manufacture is plantation grown. Para and other wild rubbers require to be washed before use, whereas to-day practically none of the plantation rubber is so treated.

The difference between smoked sheet and pale crepe plantation rubbers is largely, but by no means entirely, one of price. Smoked sheet rubber is so named because the sheets of rubber formed by coagulation of the latex, after washing and pressing, are rendered aseptic by means of a smoking process which imports the familiar deep brown shade to the rubber. A good smoked sheet usually breaks down on the mill rather more easily than pale crepe, and it is more extensively used than the latter in mixings where a bright colour is not essential. Latex is coagulated with acetic or formic acids, the amount to be used being determined by trial, since many factors can influence this figure. In the case of pale crepe the latex is diluted to about 15 per cent. and 0.1 per cent. of sodium bisulphite added as a bleaching agent; after coagulation, the sheet is washed on corrugated odd-speed rolls and dried without smoking. In the case of the smoked sheet the mills used have even speed rolls, and the sheets are dried in a smoke house at approximately 110° F. Analysis shows very little difference between smoked sheet and pale crepe rubbers, the former being a little higher in water extract; on the other hand, Para rubber usually has a higher ash and protein content than the others.

Crude Rubber Variables

Crude rubber is easily the most important of the variables which comprise the complete mix, and the methods of evaluating it and deciding how best to deal with differences between consignments are very complicated and indefinite. There is no doubt that the differences between various consignments are considerable, especially as regards the variation in the rate of vulcanisation and these differences are particularly to be observed in the case of a mix in which no organic accelerator of vulcanisation has been used. Quite recently (*Proceedings of Rubber Technology Conference*, 1938, Paper 71, p. 370) Heywood drew attention to the manner in which variations due to the raw rubber persisted and were demonstrable in the finished product. The greatest care was taken to see that the factory processing was the same in each case investigated, and it was shown that initial differences due to the types of rubber persisted in final tyres made up, variations in tensile strength, abrasion resistance, and free sulphur being clearly detected. Considerable attention is now being given to the problem of providing more uniform grades of plantation rubber.

In many factories blending schemes are practised with more or less success, but a major difficulty is that in attempting to blend rubber from different estates, which is a common method, no allowance can be made for variation between bales from the same estate; the difference in the latter case is often equal to that between different estates themselves. Probably no one would consider that any blending scheme is thoroughly efficient, but pending the production of uniform crude rubber such schemes do to some extent safeguard the position. Following the blending of a consignment of rubber by bales, it is still necessary to have a further blending when the rubber is actually cut up for use, and this type of blending is probably the most valuable part of the process. A bale of rubber is cut up into 6 or 8 pieces, preferably the latter, on a segment knife cutting machine, and each piece thrown into a separate bin. Another bale is similarly treated until 6 or 8, as the case may be, have been dealt with; thus either 6 or 8 bales are blended together before the issue of the rubber to the mixers, and while this is by no means a thorough blending of a consignment, it is a valuable safeguard which takes little space and is inexpensive to operate.

Appearance still the Chief Test

The approval of samples representative of a particular parcel of rubber is another difficult matter, and is done almost entirely on appearance standards within the recognised grades of the industry. None the less, one cannot consider that this is a satisfactory method of evaluation, since the appearance tells little regarding the physical properties of the rubber when ultimately compounded, and no satisfactory purchasing specification has so far been devised. All the difficulties which arise are accentuated by those met with in the normal physical testing of rubber as regards the methods themselves, and also in the type of test mixing which it is decided to adopt for the purpose.

The actual value gained, therefore, in testing a standard plantation rubber, except for special cases in particular mixings, is very debatable, and appearance is meanwhile likely to remain the chief test method of quality. In the case of inferior types of rubber or wild rubbers, certain tests, such as ash and acetone extract may be essential, and any departure from a recognised first-grade type naturally calls for much closer examination. Where for special reasons laboratory tests are desirable, care should be taken to see that the sample is as representative as possible of the bulk. Of the tests to be applied, those of ash and acetone extract will not usually reveal anything of value in a first-grade rubber, although these are important with wild rubbers as mentioned above. In connection with the percentage of acetone extract it is well known that the acid value is not proportionate and particularly with certain wild rubbers this latter figure is sufficiently low to affect the vulcanising properties of a test mix if additions of fatty acid are not made. This is a matter which must be watched or the test figures will be inaccurate, and if the rubber is used in production without proper provision for the deficiency in acid, poor vulcanisation will result.

Physical Tests

Physical tests are carried out on a variety of different types of mix depending on the views of those making use of them, but there does seem to be an argument for the use of an organically accelerated test mix to-day when practically all rubber mixings are so accelerated. On the other hand such a mix does mask smaller differences between rubber qualities and it can be argued that such a mix is less sensitive, although whether this is a really important point is also debatable. Unfortunately, the differences in procedure in various laboratories is such that results obtained on the same materials differ widely. In 1929 the American Raw Rubber Specification Committee investigated the procedure for testing raw rubbers very thoroughly and in the course of their work they evolved a detailed process of laboratory procedure for the carrying out of tests laid down. Samples of masticated rubber from one batch were then sent for the test to a number of laboratories for testing to the agreed procedure. Two types of mixing were used, one a simple rubber-sulphur mix, and the other an organically accelerated one, but the results obtained in both cases differed so widely as to be valueless for comparison, although in each case the agreed procedure had

been followed as closely as possible. The position regarding usual testing procedure remains much the same to-day, and it is therefore obvious that reliance must continue for the time being on visual inspection and general experience in handling rubber samples. It has been suggested that any agreed testing procedure for raw rubber should include an accelerated ageing testing, but this has not so far become of general application.

Raw rubber as received from the plantations is quite unsuited for incorporating into rubber mixing until it has been broken down into a plastic mass. It may, in fact, come into the factory in a frozen condition and, after the blending operation previously described, it is usual to store the rubber in bins at a temperature around 130° F. Failure to do so would almost certainly result in big increases in the cost of mill maintenance. After about 24 hours storing, the rubber is masticated in one of several ways. It may be done on an ordinary two-roll mill, preferably with a rather higher friction ratio than is usual for mixing, in which case the amount of softening is roughly proportional to the horsepower consumed. The process can be accelerated by taking the sheet away on a conveyor from under the mill and passing it in the form of a belt over a water-sprayed system of rollers, returning to the nip in a continuous band. In this way the rubber is cooled again on every passage through the mill nip, and consequently is broken down in a fewer number of passes.

Another method adopted in large tyre factories is to masticate rubber on what is known as a plasticator, which is actually a very large extruding machine fitted with a refiner bead. The rubber is passed through and thus mechanically worked, two of three passes being made after cooling the rubber between each. More recently the internal type mixing machine has been used for mastication, the principle being the use of high temperatures with a certain amount of oxidation. Contrasted with the old mill process where the aim was to keep the rubber as cool as possible, the latter process achieves a permanent softening by a combination of several factors. In 1936, Comes (*I.R.W.*, May 1, 1936) showed that the plasticity of rubber was reduced (that is its softness increased) as the temperature rose, but temperatures over 365° F. and preferably over 400° F. were required for the most rapid action. Such a high temperature was reached by passing steam through the jacket and rotors of the mixer and by increasing the r.p.m. of the rotors. It was found under these conditions that a time of only seven minutes was sufficient to give a permanent softening equivalent to that obtained after four hours continuous working on a two-roll mill.

Plasticity Figures from Hot Mastication

The following figures taken on an internal mixing machine by the writer show the plasticity figures obtained by a hot mastication process of this type:—

Test	Weight (lbs.)	Discharge Temperature, ° F.	Amperes	Time (Mins.)	Plasticity (Secs.)
1	224	313	250	14	$10.^{3}/_{5}$
2	224	365	200	14	2
3	224	383	180	14	$1.^{1}/_{5}$
4	224	430	180	14	$1.^{2}/_{5}$
5	200	356	180	7	$9.^{1}/_{5}$
6	200	390	160	10	$3.^{2}/_{5}$
7	200	384	160	10	$3.^{1}/_{5}$

The plasticity figure is, of course, a purely relative one, but a figure of 10 on the above method of test represents a commercial soft masticated rubber. It is therefore obvious that a very pronounced softening is obtained in a very short time. For comparison a 250 pound batch of rubber on an 84 in. two-roll mill masticated for 40 minutes, including passage through a tight nip for 16 times, would only show a plasticity, tested by the same method, of approximately 15. The figures obtained by this process are permanent, that is to say the rubber does not harden again in a reasonable time, as would be the case with rubber temporarily softened by masticating at higher temperatures than normally used on a two-roll mill.

Latex has now become an important form of raw rubber for manufacturing purposes, and it will be briefly dealt with here. When freshly tapped, latex contains 27 to 35 per cent. of rubber, 1.2 to 1.7 per cent. of acetone-soluble matter, 1.5 to 2 per cent. of protein, and about 0.25 to 0.7 per cent. mineral matter. It is a relatively coarse dispersion of negatively charged rubber in an aqueous serum, and considerable controversy has ensued regarding its structure, a discussion about which would be out of place in this article. Because of high transport costs, latex is usually concentrated to at least 60 per cent. by one of the following methods:—

(1) Creaming, in which agents, such as gelatine, gum tragacanth, etc., are added to the latex, and the mixture heated, when a more or less complete separation into two layers occurs, one containing the bulk of the rubber.
(2) Ultra-filtration.
(3) Centrifuging, when a stabiliser, such as ammonia, is added and separation effected in a separator of cream serum, giving a concentrate containing about 60 per cent. dry rubber and only a small proportion of the original serum solids.
(4) Evaporation, in which concentration is effected by heating latex in the presence of preservatives and protective colloids with or without the use of vacuum, whereby a completely reversible paste can be obtained containing 70 per cent. of dry rubber.

The last two processes appear to be the only ones to have achieved any commercial success up to the present.

Evaluation of Preserved Latex

Preserved latex is usually sold on the basis of dry rubber content and as with smoked sheet, its evaluation is a matter of difficulty. In sampling it is essential to test each drum delivered, since possible variations are greater than is the case even with different cases in a crude rubber consignment.

Total solids may be determined sufficiently accurately for works control by evaporating five grammes of the sample on a clock glass in a water oven. The figure obtained, of course, includes added preservatives as well as actual rubber. Alkali content can be determined by direct titration of the latex, after dilution, with sulphuric acid using suitable indicators; free ammonia may be estimated using a Kjeldahl apparatus.

The stability of a latex does not depend solely on the alkali added, the amount of the latter added depending in turn on the nature of the tapped latex. Information as regards stability is usually sought by determination of the pH value of the sample, for example, colorimetrically by means of the Wulff pH tester (*I.R.J.*, 1930, *79*, 353). Even this figure is not an entirely reliable criterion of the stability of a supply of latex during processing, and it is desirable to know the "buffering power" or the relative resistance to change of pH value displayed by the latex, when alkaline or acid substances are added, as may be the case in processing operations. This can be determined by studying the effect on the pH value of adding increasing volumes of standardised dilute HCl and NaOH to samples of the latex.

Theoretically, latex possesses many advantages over ordinary rubber, such as the elimination of the heavy plant required to manipulate dried rubber, improved strength and ageing of the final product, and so on. But actually the development of its use has been along new paths rather than to supersede established processes; many of the applications are outside the ordinary rubber industry. The control of latex to give uniform results is still a very troublesome matter and the water soluble serum constituents, mainly carbohydrates, and gluco proteins, tend to "bloom," and being hygroscopic may give a finished product which is somewhat sticky. The outlook is very promising in new directions, but there is as yet no likelihood of established rubber processes being superseded.

Rubber powder is another form of new material which has been developed in recent years, the rubber being produced in the form of a crumb, zinc stearate or similar powder being used to prevent the particles matting together again.

Research in the Gas Industry

Proposal to Establish Co-operative Scheme

MR. ROBERT ROBERTSON, President of the Institution of Gas Engineers, announced on Tuesday at the Institution's annual general meeting that it was proposed to establish a Gas Research Board which would, in future, be responsible for co-operative research in the gas industry. The Board would be sufficiently representative of the gas industry as a whole to satisfy the requirements of the Department of Scientific and Industrial Research if and when it was considered desirable to become so associated with the Department as to qualify for Government grants.

Functions of the New Gas Research Board

There was no intention, he said, of superseding or interfering with the work now being done by individual undertakings or contractors and, generally speaking, the functions of the new organisation would be:

(i) The collection, documentation and distribution of information regarding research work of interest to the gas industry.
(ii) The provision of a contact and co-ordinating service between research workers similarly engaged.
(iii) Observation and reporting upon work in progress.
(iv) Planning work for the future and arranging for it to be carried out.

MR. HAROLD C. SMITH, enlarging upon the objects of the Gas Research Board, said that these would be *inter alia:* (a) to promote and finance research and other scientific work in connection with the gas industry; (b) to establish and maintain a bureau of information for the benefit of members of the Board; (c) to encourage the discovery of inventions, improvements, processes, materials and designs which seemed capable of being used by members of the Board; (d) to co-operate with, become a member of, or otherwise assist the research work of any association, institution or other body whose objects included scientific or industrial research in connection with or of interest to the gas industry; (e) if and when considered desirable, to establish and equip laboratories and to pay research workers, whether in such laboratories or elsewhere, for the conduct of research; and (f) to prepare and issue detailed reports for the confidential use of members of the Board.

Membership of the Board

An gas undertaking contributing on the full scale to the national funds would automatically become a member of the Board. Firms engaged in the manufacture of gas works plant and appliances for the use of gas would also be eligible for membership at a rate of subscription to be approved by the Council of the Board. The business of the Board would be managed by a Council, nine members to be nominated by the Council of the Institution of Gas Engineers and six by the Council of the Society of British Gas Industries. The Council of the Board might co-opt not more than five additional members, who need not necessarily be members of the Board, exclusive of those who might be nominated by the Department of Scientific and Industrial Research if at any time a financial grant was made by that Department to the Board. The Council might elect its own chairman. There would be a president and two vice-presidents, one vice-president to be nominated by the Council of the Institution of Gas Engineers and the other by the Council of the Society of British Gas Industries. Sir David Milne Watson had consented to become the first president of the Board. It was considered essential that there should be at all times a full-time Director of Research or other responsible technical officer who would be appointed by the Council and entrusted with the general direction and/or supervision of the research and technical work undertaken by the Board. It was intended that Dr. Braunholtz, as secretary of the Institution, should be the first secretary of the Board.

(*Continued on foot of next column.*)

Mica Substitute

Processed Bentonite Films may go into Commercial Production in America

POSSIBLY the most interesting development in bentonite during 1938, according to the U.S. Bureau of Mines, was the discovery announced by Dr. Ernst A. Hauser, Professor of Chemistry at the Massachusetts Institute of Technology, that bentonite films, properly processed, may afford a successful substitute for mica in various important uses. The new product, which may come on the American market in at least a small way during 1939, has been called Alsifilm, emphasising its hydrous aluminium silicate composition. Possibily the first important commercial outlet will be as insulating tapes for wrapping wires and telephone cables. It is claimed that these films are fire-proof, water-proof, chemically inert, unaffected by mould, transparent, flexible, and fairly tough. They are said to take ink readily, and hence may be used for permanent documents. It is claimed also that they can be made of any desired thickness—like built-up mica or sheets of paper glued together, only without needing any additional binder. Ordinarily flexible or even crease-proof, the material may be modified in appearance and properties by incorporating various pigments and fillers.

The formation of these films is explained as due to the attachment of colloidal clay particles end to end in strings or tiny filaments that mat like organic fibres in the manufacture of ordinary paper or felt. Although produced experimentally at first in an ultra-centrifuge, the films were later manufactured by various methods. At the moment extrusion of the moist jelly seems the most practical method of commercial production because it can be embodied readily in a continuous process whereby it is believed the material probably can be manufactured at an extremely low cost. The hardening of the films to make them impervious to liquids is a separate treatment about which very little has been published.

(*Continued from previous column.*)

It was not proposed that the Gas Research Board should at present establish and equip laboratories. The unanimous opinion of the committee was that the fullest use should be made of existing research facilities in the country and that the various items of work to be done should be farmed out to those organisations best equipped to see the work through. The Director of Research would be expected to keep in touch with all research work which was carried on for the Research Board and also with other work which was being done in the gas industry or which was likely to be of interest to the gas industry. One of his first duties would be to set up a bureau of scientific and technical information, the information contained therein being available for the use of all members of the Board.

The committee was quite confident that the Gas Research Board would fulfil its objects, but preferred to prove that the success of the Board was assured before asking for a grant from the Department of Scientific and Industrial Research. At the same time a constitution had been designed, the principles of which the committee felt would generally be approved by the Department of Scientific and Industrial Research should it be decided at a later date to apply for a grant.

MR. E. V. EVANS (General Manager, South Metropolitan Gas Company; Chairman of the Research Executive Committee) said that during the last decade the amount of research undertaken for the gas industry had largely expanded and the need for centralised control and co-ordination had become a pressing one. The formation of a Gas Research Board, with a director and bureau, did not therefore constitute a revolutionary change, but was rather to be considered as a step necessary to maintain orderly procedure in the development of the industry.

By-Product Ammonia*

Manufacture of Concentrated Gas Liquor in Automatically-Controlled Plants: Its Treatment at Central Chemical Works

By

P. PARRISH, F.I.C., M.I.Chem.E., M.Inst.Gas E.

Mr. P. Parrish.

THE author's association with the by-product ammonia industry dates back to a time when it was possible to manufacture sulphate of ammonia profitably in plant units as small as 300 tons per year. In those days, fortunately, it was an easy matter to dispose of almost any quantity of sulphate of ammonia, on the basis of the market price, less 2½ per cent. discount and 1 per cent. commission, for delivery f.o.b. at the nearest British port. In the latter years of the nineteenth century there was no absence of demand, and ordinary good grey quality, containing 24 per cent. of ammonia as a minimum, with 2 per cent. moisture and 0.1 to 0.4 per cent. free sulphuric acid, found a ready market. It was invariably specified that the sulphate of ammonia should be free from cyanides. Three or four years later demand was sluggish.

With the development of processes for the manufacture of synthetic ammonia, dating from 1914 (but extending rapidly from 1926), and its conversion to ammonium products of various kinds, new factors were gradually introduced, as a result of over-production.

Eventually an international nitrogen cartel became a necessity. For some years past it has been necessary to fix quotas for synthetic ammonia manufacturers in various European countries, and compensation has had to be made to those continental and British factories which are compelled to adjust their output to the limitations of demand. Indeed, the structure of the British industry has altered, and the whole basis of sale is different from what it was in the period previously cited. Market prices to-day contemplate carriage to farmers' stations, commissions have to be paid, and there are other incidental expenses, which were unknown in the period from 1898 to 1922.

Concentrated Gas Liquor Manufacture

When it was decided to develop the embryo synthetic ammonia plant at Billingham in 1926, it was obvious that some means must be found by which concentrated gas liquor could be produced at a sensibly less cost than hitherto.

From 1929 to 1931 much attention was given to the design of concentrated gas liquor plants, but it was not until the end of 1931 that an opportunity was afforded of designing and putting into operation an automatically-operated concentrated gas liquor plant for a relatively small works, carbonising only about 3,500 to 4,000 tons of coal per annum. The reason for selecting this works was that during the night shift one stoker only constituted the personnel.

It was felt that if an automatically-operated concentrated gas liquor plant could be made to function satisfactorily at a small works, there would be no difficulty in establishing this method at other and larger works. Mr. R. J. Philp, Engineer and Manager of North Berwick Corporation Gas Department, indicated in some detail in a contribution to the North British Association of Gas Managers (*Gas J.*, 1932, *199*, 645) the particulars of this initial attempt, and the success which had accompanied its operation.

This plant was of the Thorncliffe-Baldurie type, and consisted of

(a) A special still, 18 in. in diameter, with 11 sections, 9 in. in depth, fitted with bubbling hoods, overflow pipes and access doors for cleaning purposes.

(b) A preheater and condenser of the concentric tube construction, having tubes of 1½ in. bore by 6 ft. 7 in. in length, and external tubes of 3 in. bore by 6 ft. in length, connected by suitable headers.

(c) An overhead cast iron storage tank, 12 ft. × 8 ft. × 4 ft., for concentrated gas liquor.

(d) A scrubber to absorb the ammoniacal air discharged from the concentrated gas liquor tank.

Principles of Automatically-Controlled Plant

What was contemplated, in this design, was that the gas liquor should be pumped from the feed supply tank to the preheater and thence to the still, the gases from the still being used to preheat the liquor, and finally condensed and gravitated to the concentrated gas liquor storage tank. A water supply was fixed to the condenser, but in actual practice little water was used. The pump was of the rotary type, steam-driven.

On the pipe connecting the still to the preheater there was fitted an "Arca" thermo-relay and pressure regulator, actuated by the temperature of the vapours leaving the still, so that a constant still-head temperature could be maintained. On the steam inlet to the still was fixed an "Arca" control valve, the function of which was to maintain a constant pressure of steam. The quantity of steam passing the steam valve was a measure of the liquor throughput of the plant, and the pressure gauge on the control steam line could actually be calibrated in terms of ammoniacal liquor per hour.

No plant is entirely automatic unless it is foolproof under any condition that might arise. If pressure accumulated in the condenser, due to the formation of ammonium bicarbonate, it was transmitted through a relay to the liquor valve, which shut immediately. The steam valve remained open, however, permitting steam to pass through the preheater and condenser, the blockage being thus automatically removed The pressure then fell, and the liquor valve automatically re-opened, the plant reverting to normal operation.

Dealing with a Permanent Blockage

If the blockage, for some reason, had become so permanent that this automatic steaming did not remove it, pressure in the still base would increase. Another pressure relay, connected to the steam valve, was so arranged that if a predetermined pressure was exceeded, the steam valve would close, and the plant would automatically shut down.

In 1933 it was found desirable to deal with the permanent gases leaving the scrubber, and a purifier was installed for the absorption of H_2S. A cover was also provided to the gas liquor tank, and a steam coil was installed in the concentrated

* Extracts from a paper presented on Thursday at the annual general meeting of the Institution of Gas Engineers.

gas liquor tank, in order to maintain a suitable temperature for loading.

Several plants of the foregoing type were erected, of varying capacities, and all have worked in a satisfactory manner and afforded a means by which concentrated gas liquor containing 15 per cent. of ammonia by weight could be produced for about 8s. per ton.

Many years' experience of the design and operation of concentrated gas liquor plants, automatically-controlled, reveals that the characteristics of the gas liquor vary at most gas works, with (a) variations of the quality of the coal carbonised; (b) the control exercised; and (c) the type of plant. Similarly, the operation of concentrated gas liquor plants differs not only with such changes in the quality of the gas liquor, but with its temperature, which may be as low as 10° C. in the winter, and 24° C. in the summer. Equally, it is known that the temperature of the cooling water employed varies between 10° C. in the winter, and 24 to 26° C. in the summer.

It is essential, therefore, that concentrated gas liquor plants should not only be of adequate design to afford the necessary flexibility, but should provide equipment to admit of modification of control to meet the varying conditions that are likely to be encountered.

Alliance with Existing Chemical Works

If gas undertakings are to receive the maximum benefit under a central scheme they must ally themselves with an existing chemical works, geographically well-situated, having a sulphuric acid plant of flexible capacity, and preferably having a demand for sulphur material and ammonium products. Their production of sulphur material, spent oxide, should be no less the subject of sale than concentrated gas liquor. Such an arrangement would appear to be essential, as the two products are inter-dependent, and will become increasingly so as time elapses.

The directors of the central chemical works must be prepared to purchase the sulphur material, spent oxide, on a sliding scale basis, dependent on the price realised in this country for the sulphur content of pyrites, bearing in mind that most pyrites are arsenical, whereas spent oxide is generally commercially free from arsenic. Equally, the directors must be prepared to adopt a sliding scale basis of purchase for concentrated gas liquor, dependent on (a) variations in the market price of sulphate of ammonia in 6-ton lots, delivered to farmer's station, as declared from time to time by the British Sulphate of Ammonia Federation, Ltd., and (b) the ammonia content of the concentrated gas liquor. The directors of the chemical works, in fixing such sliding scale prices, must be prepared to allow a reasonable percentage of their reduction of standing charges arising from increased make of products, as applying to the manufacture of sulphuric acid and ammonium products, to be assigned for distribution to the gas undertakings. Such sum can be appraised initially, and commuted into the sliding scale figures.

Failing such an arrangement, there should be participation in the surplus profit by the gas undertakings on, say, an equal basis, after a predetermined profit has been realised by the chemical company. A formula can easily be established, by mutual consent, for the determination of the profits, and mutually-appointed auditors can ascertain this figure, if need be.

Manufacture of Sulphuric Acid from Saturator Gases

Deliveries of concentrated gas liquor began to increase so rapidly at the chemical works with which the author is connected (Phœnix Wharf Chemical Works, South Metropolitan Gas Co.) that it became necessary, early in 1934, to consider the form which a new sulphuric acid plant should take, to deal exclusively with the saturator gases.

An investigation of the Metallgesellschaft Aktiengesellschaft contact process, using a wet vanadium catalyst, was made first, but this process proved to be too expensive for adoption, particularly as regards capital expenditure. A "nitrose" process involving a tower system, was then designed, as representing the best form of plant.

The stages of the process, represented in their simplest form, are as follows:

(*a*) Combustion of hydrogen sulphide:
$$H_2S + 1\tfrac{1}{2}O_2 = SO_2 + H_2O.$$

(*b*) Oxidation of sulphur dioxide by the atmospheric oxygen, in the presence of oxides of nitrogen as a catalyst, and water vapour:
$$SO_2 + \tfrac{1}{2}O_2 + H_2O = H_2SO_4.$$

(*c*) Oxidation of the nitric oxide:
$$2NO + \tfrac{1}{2}O_2 = N_2O_3$$

This is essentially a time reaction and such oxidation occurs in a large void Gaillard-Parrish tower chamber.

(*d*) Absorption of N_2O_3 in cold 80 per cent. H_2SO_4 in the Gay-Lussac towers:
$$2H_2SO_4 + N_2O_3 = 2HNSO_5 + H_2O.$$

(*e*) Denitration of the nitrous acid in the Glover towers by the burner gases arising from the combustion of H_2S:
$$2HNSO_5 + SO_2 + 2H_2O = 3H_2SO_4 + 2NO.$$

(*f*) Nitrogen oxides are derived from the oxidation of ammonia

The plant was designed in such a way as to be flexible. It was intended to produce 75 tons of 70 per cent. acid per week, and subsequently to increase this to 100-120 tons per week, by the introduction of a waste heat boiler, intended to effect thermal interchange between the hot burner gases—between 750 and 760° C.—and zero hardness water, in the production of steam. A reduction of the temperature of the burner gases will admit of an increase of capacity of the plant.

Manufacture of Sulphate of Ammonia

The manufacture of sulphate of ammonia from concentrated gas liquor and sulphuric acid should not constitute an insuperable difficulty. The standard type of sulphate of ammonia plant clearly calls for modification, or better still, new plant of suitable design should be installed.

The concentrated gas liquor should be preheated by the hot waste gases from the saturator to a temperature of, say, 90° C., and the still-head temperature should be maintained at not less than 85-86° C., if a suitable and inexpensive carrier for the ammonia is to be provided, and the necessary velocity through the perforations of the cracker pipe, essential for the support of the crystals during formation, is to be obtained. Difficulties will be encountered from "gas locks," unless a suitable form of preheater is arranged. Other special provisions are also necessitated. (B.P. 437,681).

The tendency for many years has been for saturators of unwieldy dimensions to be erected, and arranged in a way rendering support of the crystals almost impossible. Nine or ten years ago the designers of saturators for the treatment of synthetic ammonia were the worst offenders in this respect. Saturators were apparently modelled on the lines of by-product coke oven practice, and no regard was given to the chemical engineering data so essential for an appreciation of what was required.

The crystals first formed in the manufacture of sulphate of ammonia are small. Given the correct starting conditions, they will grow if they are suitably suspended in the mother liquor from which they are first formed for a given time, and if the temperature and free acid content of the mother liquor are maintained reasonably uniform at all times.

The Future

With the increasing availability of waste heat steam, all gas works should be in a position to manufacture concentrated gas liquor profitably. This should be sent to a centrally-situated chemical works, having the facilities already indicated. Such chemical works should manufacture those ammonium products which are calculated to ensure the nighest revenue.

Where sulphate of ammonia is manufactured, the plant should be in units with a capacity of not less than 50 tons per day, using exhaust steam from pass-out turbines or back-pressure engines. In this way mechanised plants can be

operated at a minimum of cost, from the point of view of labour and motive power, and the exhaust steam can with advantage be used for process work. Whether an attempt should be made to dispense with centrifuging, neutralising and drying, on the lines of the Fauser reaction chamber, of whether the Escher-Wyss automatic discharge centrifuge, which is the nearest approach yet to a continuously-operating machine, should be used, is a matter for careful consideration. That fertiliser products can be manufactured profitably at such central chemical works is certain, having regard to the facility with which crude liquor ammonia can be manufactured in automatic plants, and equally profitably converted to nitric acid.

In view of the availability of surplus sulphur material in the form of spent oxide, phosphoric acid or calcium superphosphate, both of which involve the manufacture and use of sulphuric acid, should be produced, unless other arrangements can be made for the realisation of the maximum market value of spent oxide.

Testing of Vegetable Adhesives

New Standardised Methods

IN view of the desire for some standardised methods for the testing of vegetable adhesives, B.S. 844 has just been published by the British Standards Institution. The methods are intended to apply to such vegetable adhesives as are manufactured from starch or from material containing a high proportion of starch, such as wheat flour and potato starch. Typical adhesives of this type are crystal gums, dextrins and water-soluble pastes and powders.

The physical and chemical properties of vegetable adhesives depend, first, on the nature of the raw materials, and, second, on the methods of processing. It is not possible to draw up any simple tests which will evaluate completely the quality of an adhesive, or its suitability for a particular trade. The tests included, however, provide indications of the behaviour of the adhesive in use, and may be taken as reliable criteria of the quality of different deliveries.

Relative Importance of the Tests

The relative importance of the tests described depends very largely on the purposes for which the adhesive is intended. In practice it is usual for the consumer to find by experience the most suitable type of adhesive for his purpose. The problem then reduces itself to checking future deliveries in respect of those properties which are relevant. Some of the physical tests, for example, the foam test, are of an empirical nature, but if the methods are carefully followed, consistent results are obtainable which will give useful information both to the manufacturer and to the user.

The committee which has drawn up the methods is fully aware of the importance of such tests as surface tension, balling, tackiness and rate of setting, and of the unsatisfactory nature of the viscosity tests. It is realised that the performance of the adhesive on the machine could probably be defined by these five tests and the absence of the first four from the list of standard tests is felt to be a serious omission. Some work has already been done, particularly on tackiness, rate of setting and viscosity at machine consistencies, but the tests as they stand have not been developed sufficiently far to admit of standardisation at present.

Where possible, the tests have been divided into approximate and standard tests. The approximate tests are primarily intended for routine purposes and for such cases where extreme accuracy is not required. The standard tests on the other hand, should be carried out by skilled operators for much more precise and reliable results and are also intended for use in case of dispute.

Copies of this new British Standard (No. 844-1939) B.S. Methods of Testing Vegetable Adhesives, can be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1 (price 2s., post free 2s. 2d.).

Chemical Matters in Parliament

Subsidies to Industries

IN the House of Commons on Monday, Mr. Mainwaring asked the Financial Secretary to the Treasury whether he would provide a statement showing the list of subsidies and grants given to industries since January 1, 1932, indicating those payable in 1939.

Captain Crookshank, in reply, gave particulars of the subsidies payable since January 1, 1932, including details concerning beet sugar and land fertility improvement. He stated that the beet sugar industry received £18,594,585 during the 1932-38 period and £3,000,000 was the amount included in the 1939 Estimates for the industry. Land fertility improvement received £1,961,513 from 1932 to 1938 and for 1939 the amount included in the Estimates was £1,500,000.

Sugar Duty

Mr. Denville asked the Chancellor of the Exchequer on Tuesday what was the basis of extraction of sugar on which the new scale of Customs Duty on raw sugars was based, and in particular what was the normal yield in good refining practice as estimated by His Majesty's Customs of sugar and molasses from a cwt. of raw sugar polarising exceeding 96 degrees and not exceeding 97 degrees, on which duty was chargeable at the full rate, of 10s. 5.4d., and what would be the drawback payable on such sugar and molasses when exported; and what was in the case of such sugar, the amount allowed per cwt to give effect to the principle that the refiner should be recouped for expenses involved in payment of duty on his raw material?

Sir J. Simon replied: The basis of the new full rates of Customs duty on raw sugar is the scale contained in the First Schedule to the Finance Act, 1901, and repeated in the Sixth Schedule to the Sugar Industry (Reorganisation) Act, 1936, representing the estimated yield of refined sugar extractable in ordinary refining practice from raw sugar at the various degrees of polarisation, including sugar at 96-97 degrees of polarisation. Drawback on the exportation of sugar refined from raw sugar polarising at 96-97 degrees on which duty was paid at the new full rate, is payable at the rate of 11s. 8d. per cwt., and on the exportation of molasses produced in the refining of such sugar, at rates varying from 2s. 9½d. to 8s. 9d per cwt. according to the sweetening content of the molasses. The amount allowed in the 1901 scale to give effect to the principle that the refiner should be recouped for expenses involved in the payment of duty on his raw material cannot be stated, as the detailed calculations on which that scale was based are not now available.

Silicosis

Mr. J. Griffiths asked the Paymaster-General, as representing the Lord President of the Council, whether he could give any information on the experiments carried out by mining engineers in Canada into the prevention of silicosis by the disposal of quantities of metallis aluminium powder in dust clouds in mines; and whether, in view of the success claimed for this method of prevention, he would have similar experiments conducted in this country?

The Paymaster-General (Earl Winterton): The special committee advising the Medical Research Council on industrial pulmonary diseases is maintaining close contact with the Canadian investigators of this method, and some related experiments are being made here under the committee's direction.

Mr. Griffiths: Can the right hon. gentleman say when these investigations will be completed?

Earl Winterton: No, sir. Experiments are still being carried out, and it is proposed to send a research worker to Canada.

Italian Fuel Developments

Discussions at National Meeting at Rome

A NATIONAL fuel meeting was held recently at Rome in conjunction with the Italian Mineral Self-Sufficiency Exhibition and for the purposes of discussion the meeting was divided into the following five sections: Research and extraction of coals to replace imported fuels; the search for oil in Italy; oil extraction from asphaltic rocks and bituminous schists; recovery of motor fuels from oil, coals and lignite; use of natural and refinery gas.

Problems of a Geological Character

In the first section several speakers dealt with problems of a geological character and with the utilisation of extracted materials, among them being Signor Vacca, who spoke on the piceous lignite of Cadibona, Dr. Mortillaro, who dealt with researches carried out in the anthracitic territory of Ogliastra, Sardinia, Signor Mario Ceccarelli who stressed the uncertainty in the technique of the utilisation of national fuels, Signors Alberti, who reviewed jointly economy in the consumption of national coal, and Signor Buffa, who spoke on the adaptation of combustion plants to national needs. Signor Remo Contini dealt at length with the search for oil in accordance with the principles of the "Azienda Generale Petroli A.G.I.P.," the oil company founded by the Government. Professor Sacco, Ing. Gallazzi and Ing. Gavotti spoke on drilling problems, and Ing. Zuber on the territorial distribution of the oil fields in the Po valley.

Italy's great quantities of asphaltic rocks and bituminous schists were discussed by Professor Giorgio Roberti, who spoke on oil extraction from these materials. He stated that it was estimated that there were 500 million tons of asphaltic rocks and bituminous schists in Ragusa and Sicily, and one to four billion tons in Abruzzi. A modest estimation based on one billion tons with an average bitumen content of four per cent. indicated that Italian asphaltic rocks could yield more than 40 million tons of crude oil. For such production, however, it was necessary to carry out geological studies and to devise means for extracting the crude oil and for transforming it into finished products. This process was at present being carried out satisfactorily by the Bari and Leghorn works of the Azienda Nazionale Idrogenazione Combustibili A.N.I.C. Referring to the process of extraction, Professor Roberts mentioned the heat treatment which was being carried out at the Ragusa furnaces of Ing. Roma by which it was possible to extract 85 per cent. of the bitumen contents of the rocks. He mentioned also the process of extraction by solvents, used by the Società Salomea and by Signor Salerni on the rocks of the Abbruzzi territory.

The Recovery of Motor Fuels

In the fourth section Professor Pastonesi spoke on the recovery of motor fuels from oils, coal and lignite. He examined and compared the usual systems of recovery of motor and aircraft gasoline from solid and liquid fuels, the layout of the plants both of the gasification and synthesis system and of high temperature and pressure hydrogenation. He pointed out the principal features of both the systems and the qualities of the products which could be obtained from each one of them and referred to the two works of the A.N.I.C. at Bari and Leghorn, which were not only producing motor gasoline, but also high anti-detonating aviation petrol, lubricants and paraffin.

Professor Natta lectured on the gasification of lignite and production of high octane number motor fuels from water gas. He stated that the comparison between the various coal gasification processes for the production of water gas by synthesis showed that the processes based on the gasification by oxygen and steam were of a particular interest for the gasification of Italian fuels. He mentioned the results of the gasification of various fuels by the different gasification systems, with particular reference to the results obtained with some Sardinian coals by means of a special oxygen generator, by which it was possible to obtain an amount of one to two cubic metres of water gas, having hydrogen content double that of carbon monoxide, from each kilogram of coal. Comparison of the different synthesis processes of motor fuels from water gas showed that the high pressure process gave the best results and required a smaller capital outlay than the low pressure processes. The synthesis of the higher alcohols was also considered.

Professor Padovani read a paper on the utilisation of natural and refinery gases in home and industrial heating plants, in electric power stations and in stationary engines. He spoke on the possibility of compressing and liquefying them or transforming them chemically for transportation in bottles or in lagged vessels. For using them directly it would be necessary, he said, to devise combustion plants in accordance with the particular characteristics of the gases. Propane and butane in particular were liquefied and introduced into independent vessels because they could be easily liquefied at low pressures and normal temperatures. For gases which were difficult to liquefy, high pressure could be used (from 150 atm. up) in order to fill air bottles for motor traction. These gases could also be liquefied at low temperatures and transported by means of lagged vessels to be evaporated again and then compressed on the spot of their utilisation. As to chemical transformation, this offered good possibilities for the non-saturated components, essentially olefinic, which, although not contained in the natural gases, were always present in the refinery gases and could be oxidised, hydrated, polymerised, chlorinated, sulphonated, etc., to make them suitable for the production of a great variety of products, such as high octane number gasolines, special lubricants, solvents, resins, synthetic rubber, etc. Chemical transformation of the saturated components was more difficult and this applied particularly to methane which was an important component of cracking gas and practically the only component of the natural gases. It was, however, possible, even with methane, by means of regulated high temperature cracking and special electric treatment, to obtain liquid products, such as aromatic hydrocarbons, as well as hydrogen, carbon and acetylene. The transformation of methane into important products could also be achieved by chlorination. Of all transformations, however, the most important appeared to be catalytic or non-catalytic treatment with different oxidising gases, into mixtures of carbon oxides and hydrogen, from which ammonia, liquid and solid hydrocarbons (Fischer gasolines and paraffins) methyl alcohol, formaldehyde, etc., could be produced.

Ing. Giarratana, in closing the meeting, insisted upon the necessity of carefully classifying the natural gases existing in Italy, and of estimating their exact amounts so as to develop their applications rationally.

AN ECONOMIC DEGREASING SOLVENT

Dr. Alexander Wacker, Ges. in French Patent No. 832,580 propose the use of tetrachlorethylene for degreasing and cleaning metal objects. It should be used at a temperature between 70° and 90° C., that is, below its boiling point, and the loss of solvent at this temperature is extremely small, it is claimed, for it is not until the tetrachlorethylene actually boils that there is any serious loss. It is admitted that this is rather unexpected, since trichlorethylene used in similar circumstances has very high evaporation losses. Tetrachlorethylene has, in other respects, similar characteristics to trichlorethylene, and can be used in the same apparatus as that employed for the latter solvent.

SPECIAL COPPER SECTION

Foreword

By
G. W. PRESTON
(General Manager, Copper Development Association)

COPPER has been described as a material "old as time, modern as to-morrow," and indeed such a phrase helps us to recall that not only was copper the first metal to be usefully employed by man many thousands of years ago, but that it is still to-day the world's most important non-ferrous metal. During the last five years the consumption of copper in this country has been more than doubled and has reached a level appreciably higher than at any previous period, even including the war years and the boom year of 1929.

The amount of copper and copper containing materials absorbed for armament purposes is less than is popularly assumed, and to-day, as in more normal times, the bulk of the metal is being utilised for ordinary industrial purposes. It is inevitable that with the ever changing trend of design and of the requirements of industry, the application of constructional materials must also change. Progress within the metal industries themselves, however, continues with equal rapidity, and research and development are continually pointing the way to new applications and improvements in the old.

In the copper industry progress has been steadily maintained. New sources of supply of the metal have been developed, and refining and production processes improved so that to-day the industry is better equipped than ever before to meet the needs of users.

This progress is particularly evident in the ample facilities which now exist for meeting readily any demand which may arise for copper, thus promoting the maintenance of a steady and satisfactory market price level, and in the development of new and improved copper alloys capable of meeting a very large variety of modern industrial needs.

Copper and copper alloys to-day provide the designer with materials of great corrosion resistance and excellent physical properties ranging from soft and ductile copper to alloys with mechanical properties akin to those of the finest hardened alloy steels.

The simple terms copper, brass and bronze no longer designate adequately the character of available materials, the range of which has become exceedingly complex and specialised. More than ever is a readily available source of technical information on such matters needed, and it is for this reason that the Copper Development Association (Thames House, London, S.W.1) is maintained by the copper industry to act as a central bureau of information from which assistance, when required, is obtainable without obligation.

Copper and its Alloys in Chemical Engineering

By
STANLEY BAKER, Ph.D., M.Sc., A.I.C.

THE extensive use of copper as a material of construction for chemical plant is largely due to the high degree of resistance which this metal and its alloys offer to the corrosive action of a large number of substances. Furthermore this property is combined with excellent ductility and moderate strength so that fabrication of even complex shapes is comparatively simple and the construction can be comparatively light. Copper is nearly always used in the wrought condition and this also enables the weight to be kept lower than would be the case with castings, since casting necessitates a minimum thickness which is frequently in excess of that required from a constructional point of view.

Copper commercially available to-day, which is used to produce the sheets and tubes which form the raw material for the plant manufacturer, is of high purity, generally of the order of 99.9 per cent. copper, the principal other element present being oxygen.

Oxygen is normally present in commercial "tough-pitch" copper to the extent of 0.02 to 0.08 per cent. The oxygen is present as cuprous oxide and is purposely regulated within the above limits as thereby the copper has the best combination of physical and mechanical properties. One disadvantage of the oxygen, however, is the increased difficulty it causes during welding. The cuprous oxide reacts with reducing gases such as hydrogen in the flame to form water vapour, giving rise to unsoundness in the weld, and causing embrittlement. In the last few years a special type of copper has been developed from which all cuprous oxide has been eliminated by the addition of phosphorus before casting. This product is known as deoxidised copper, and is particularly suitable for welding. Its mechanical and physical properties differ only slightly from tough pitch copper, except that the slight residual phosphorus content lowers the conductivity to some extent.

Arsenical copper, which may be either tough pitch or deoxidised, usually contains from 0.3 to 0.5 per cent. of arsenic, which gives increased strength at moderate temperatures by raising the annealing point, and appears under certain conditions to increase the corrosion resistance. Arsenical copper is therefore very widely used for general and chemical engineering work. The properties of copper may be summarised as follows:

Physical Properties.

Atomic weight	63.57
Melting point	1,083° C. (1,981° F.)
Specific gravity	8.93
Specific heat	0.092
Coefficient of thermal expansion	16.6 × 10^{-6} per °C.
Thermal conductivity	0.92 cal/sec/cm²/°C. per cm.

Mechanical Properties.	Annealed.	Cold worked.
Tensile strength tons/sq. in.	14-15	20-30
Hardness (Brinell)	45-55	80-100
Elongation % on 2 in.	50-60	5-20
Modulus of elasticity	18×10^6 lb./sq. in.	

These figures represent average values for commercial forms of copper, and can be used for all practical purposes. The wide variation in the figures for the "cold worked" material is due to varying amounts of cold work which are normally practicable on different thicknesses of metal. Thus with fine wire, tensile strengths of over 30 tons can be obtained, while with thick plate the figure is closer to 20.

Properties of Annealed Copper in Plant Design

As a general rule in designing plant the properties of annealed copper are used, since in most cases the metal must be hot worked to shape, and welded. The strength of welds depends to a large extent on the skill of the welder, and if the work is properly carried out and suitably annealed and hammered the strength of the weld should be little, if at all, inferior to that of the parent material.

The high ductility of copper—as evidenced by the elongation values quoted above—is responsible for the ease with which copper can be worked into various shapes. This working hardens the metal, but the ductility is readily restored by annealing; alternatively, the metal may often be worked above the annealing temperature. Though annealing of copper can be effected by heating for a long time at a temperature as low as 200° C., in practice a temperature of 500° C. or even higher for a short time is more general. After annealing, copper may either be air cooled or quenched in water, the latter being more common as it saves time and also removes scale and dirt.

The presence of quite small proportions of some elements such as arsenic, silver, and nickel raises the annealing temperature of copper to a considerable extent, amounting in the case of 0.1 per cent. arsenic, for example, to about 100° C.

In recent years much more attention has been given to the creep of metals, as on this property depends the ability of plant to retain its dimensions over long periods. The data available on the creep of copper are very limited, though enough has been done to show that with the factors of safety normally allowed in design, the stress will be less than that required to give the maximum permissible rate of creep.

The raw materials of the copper plant manufacturer are generally plate, sheet, tubes, rod and extruded sections. As a rule the plant is made by hand by shaping and joining appropriately cut sheets, though in some cases where a number of similar articles are to be made, mechanical presses are used for the forming operations.

Joining the Metal Satisfactorily

Several methods of satisfactorily joining copper are available, the choice depending on the conditions to which the joint will be subjected in service. Where corrosive liquids are being handled autogenous welding or riveting is necessary, as by this means the possibility of any electrochemical action is avoided. The most general method of welding copper is by the oxyacetylene flame, though for thin material electric welding may be used. Thin sheets can be welded without a filler rod, while for thicker material, filler rods of copper or copper containing small quantities of other elements to act as deoxidants or to improve fluidity, are used. The function of the deoxidant in the filler rod is to prevent the formation of cuprous oxide in the weld due to pick-up of oxygen from the flame or from the air which would produce unsoundness. It is usual to coat the metal in the vicinity of the weld with flux to prevent access of oxygen to the weld area. Owing to the high thermal conductivity of copper, a high rate of heat input is required, and preheating is frequently necessary, while for large work two flames are generally used.

Where the liquids being processed are not highly corrosive, other methods such as bronze welding or brazing may be employed. In bronze welding the filler rods used have melting points considerably below that of copper and the copper itself is not melted during the operation; therefore it is not necessary to arrange for such a high heat input as in autogenous welding.

Brazing gives very satisfactory joints and is the most common method of joining large tubes, flanges, etc., though owing to the greater liability of the brazing metal to corrode, it is rarely used for long seams in vessels holding corrosive material.

Copper tubes are available in a great variety of sizes and gauges. For many purposes the standard type of light gauge tubing such as is used for water services can be used with advantage: particularly for auxiliary plant in a works, such as water, oil and steam services. Light gauge tubes are readily joined either by compression or capillary fittings and their advantage lies in the fact that the thickness of the wall is chosen more nearly to conform to the actual strength required, without the necessity of having additional thickness of wall to allow for cutting screw threads.

Examples of units which are made of copper are the stills, columns and condensers in the distillation of a large number of liquids such as potable spirits, alcohol, acetic acid, pharmaceutical products; while copper tubes are used in evaporators in very many industries since the absence of corrosion products and the high thermal conductivity of the metal lead to a high overall rate of heat transfer.

Numerous Alloys Available

Numerous copper alloys are available for service where a corrosion resistant material is required having greater strength than copper, or where castings for such parts as pumps, valves and fittings are necessary. Copper itself is rarely used as a casting, nor is it as easily machined as most of its alloys.

Various elements are added to increase strength, the principal being zinc, tin, nickel, aluminium, silicon and beryllium, while iron, manganese and lead are also often present in small amounts. The corrosion resistance of alloys containing up to say 10 per cent. of other metals is not as a rule greatly different from that of copper itself, and generally speaking electrochemical action need not be anticipated due to the union of the alloys and copper.

The most common alloys in general engineering practice are the copper-zinc alloys or brasses, containing from 30 to 40 per cent. of zinc. For chemical process work, however, their utility is restricted as they do not possess such a high degree of corrosion resistance as many other alloys. They are, however, used as tubes in evaporators handling some liquids, and as castings for valves and fittings.

Tin-bronzes can be used either in the wrought form or as castings: in the former state they usually contain about 6 per cent. and in the latter about 10 per cent. of tin. Phosphorus is generally added during melting to act as a deoxidiser and residual amounts up to 0.5 per cent. may be present, the alloys being frequently termed phosphor bronzes. The wrought forms have a high strength combined with good working properties and are used in the form of sheets and tubes in the construction of pressure units, while the castings are valuable for pumps, valves and fittings. Copper alloys containing both tin and zinc are very freely used both for tubes and castings.

Importance of Monel Metal

The most important copper-nickel alloy is Monel metal, containing approximately 66 per cent. nickel and 30 per cent. copper. This alloy finds applications for a number of purposes where its corrosion resistance is better than that of copper, as for example in contact with alkalies. It is also used to a considerable extent in the food industry. Monel metal is also used for valves, pumps, etc., and is particularly suitable for work at fairly high temperatures. Other alloys containing up to 30 per cent. nickel, the balance being copper,

are used for tubes which have excellent resistance to impingement attack.

Aluminium bronzes containing from 5 to 10 per cent. of aluminium are copper alloys of high strength and excellent corrosion resistance. Against certain types of corrosion they show greater resistance than copper on account of the protection afforded by the layer of aluminium oxide which forms on the surface. This is particularly effective against the action of sulphuric acid of moderate strength, and also against oxidation at high temperatures—hence its use for the bottoms of varnish kettles and other constructions exposed to heat and to the effect of flue gases which contain sulphur oxides. These alloys are also used for pumps, valves, etc.

Silicon bronzes have been used for some years abroad, though their development for constructional work in this country is fairly recent. The amount of silicon present is about 3 per cent. in these alloys, which also generally contain about 1 per cent. of other elements. The alloys have a strength almost twice that of copper, and can be readily welded, since the thermal conductivity is about that of steel and therefore the necessary heat input during welding is easily attained. The corrosion resistance is in general similar to that of copper.

Beryllium bronze, containing up to about 2.5 per cent. of beryllium, has the advantage of being heat-treatable to give an alloy having extremely high hardness and strength comparable with those of special alloy steels. This alloy can therefore be used to make tools such as spanners and chisels; while its high fatigue strength renders it valuable for springs and diaphragms. The articles can be made from the comparatively soft material and the high hardness developed merely by heating at the appropriate temperature. This alloy, though expensive, is very well adapted for use when non-sparking tools are required.

In the processing of certain foodstuffs where any trace of copper would be objectionable in the finished product, the copper plant is frequently lined or otherwise coated. An example is the very wide use made of tinned copper in the milk industry, when the absence of the coating may lead to the development of an undesirable flavour owing to minute traces of copper being dissolved—although the amount so dissolved will have no adverse effect on health.

Silver is sometimes used as a coating for copper, particularly where the very corrosive acetic acid and certain other organic acids are being distilled, and the highest degree of purity of product is required.

Copper-clad steel has been developed recently for use for chemical plant. Its use has been mainly confined to Germany where economy in the use of copper is of prime importance. It is doubtful whether under ordinary circumstances such a material would show any constructional or economic advantage over an entirely copper or copper alloy construction, except when high temperatures and pressures are involved.

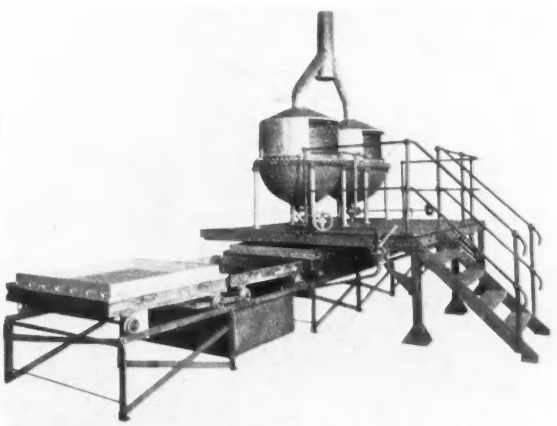
Copper and Copper Alloys : Some Aspects of Application for Plant

By
A. G. WRIGHT

As a material for the construction of chemical plant, copper has had usage over a period of time which far exceeds that claimed by any other metal. It is due to this, no doubt, that certain industries adhere so rigidly to the use of copper as a constructional metal irrespective of what advantages are put forward in support of the adoption of other metals. In other words there are industries, such as brewing and distilling, which show no desire or necessity to make any change from custom. Apart from this, however, copper has certain distinct advantages in connection with its good heat transference, and as so many chemical processes depend in one respect or another upon transference of heat—either heating or cooling—copper gains a distinct place among chemical plant materials.

There is little doubt that many users of chemical plant would find favour in copper if once they made a change in that direction and there was no outstanding disadvantage; indeed, some potential users are rather inclined to regard copper as an old-fashioned chemical plant metal because it was used when processes were far more elementary than they are at the present time. It is true that copper does not possess the chemical resistance which is expected of it due to its low position in the electro-chemical series. In most corroding media it is slowly corroded in the presence of air or oxidising agents due to depolarising action and the ease with which soluble oxides are formed. Copper, nevertheless, finds very satisfactory use in those processes where any such action does not predominate, and although some of the newer metals and alloys are known to have replaced copper this change over has not been brought about by the unsuitability of the metal.

Copper and copper alloys have long found good use in providing equipment for the continuous distillation of acetic acid and for processes in which acetic acid is produced or employed as part of a chemical reaction. In addition, the pure metal meets with very little competition in equipment made especially for the fermentation and alcohol industries. It is here that its good heat conductivity gives it distinct advantages over other metals and alloys; in addition, some of the equipment is of complicated shape and this requires a metal which may be fabricated without difficulty. In the wood distillation industry copper plant is used for distilling pyroligneous acid and wood alcohol; also for the construction of equipment for handling turpentine and resin, as well as special oils obtained from wood. Use in acetic acid processes has already been mentioned, but there are many fatty acids other than acetic for which copper apparatus can be

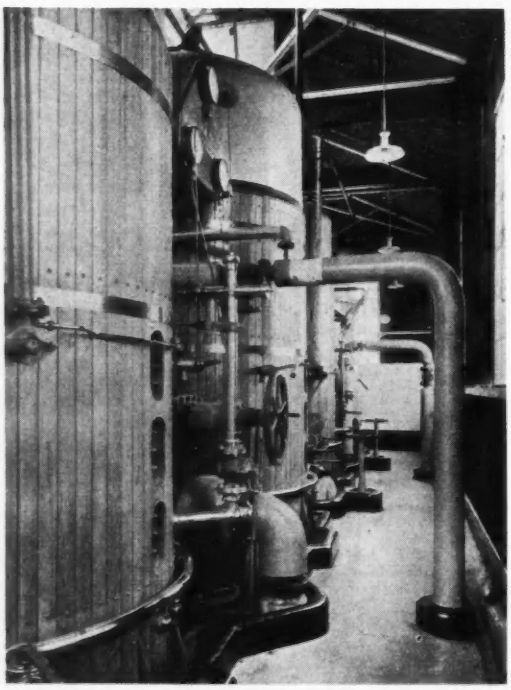


A large copper re-crystallisation plant constructed by William Brierley, Collier and Hartley, Ltd. On the steel platform are two steam jacketed pans with bottom outlets which feed the trays shown underneath. These trays are fitted with gauze strainers through which the material flows back to the storage tank seen on the floor. A hand pump is fitted to the platform to feed from the storage tank to the pans.

used advantageously, even if it is necessary to go to the trouble of conducting a process in the absence of air.

It is mainly in the presence of air while a process is in progress that corrosive influence takes place, but even this disadvantage can be greatly reduced if special precautions are adopted, or, better still, if the process is carefully studied in all features so that optimum conditions may be followed for reducing possible corrosion to the minimum. As one example of this case of fitting conditions to make it possible to use copper in place of other metals, with the distinct advantage of gaining its good heat conductivity and ease of fabrication to difficult shapes, much can be gained by a study of the brewing industry and of certain aspects of the manufacture of food products.

There are now well over 2,000 copper alloys in which the main alloying agents are zinc, tin, aluminium, nickel, iron, silicon and phosphorus, and nearly every one of these alloys is a potential material from which plant for the chemical and chemical-using or allied industries may be made. Some of the alloys are known to be usable for many of the common



Two double effect standard calandria type evaporators recently fabricated in copper throughout by S. Briggs and Co., Ltd.

corrosives, such as acids, salts or alkalies for which copper itself could never be recommended. Other alloys are placed in the category of being useless, although their uselessness is more inferred than proved. Were it not for such an alloy as Everdur, which consists of copper 96 per cent., silicon 3 per cent. and manganese 1 per cent., the task of recovering furfural from oat hulls would not be facilitated to the extent that it has been in establishing the relatively new furfural industry interests. Indeed, no other metal has proved itself so satisfactory for the construction of the large digestors which are necessary to the furfural extraction process, as evidenced by plant which is in operation in the United States.

Considering copper alloys generally in the chemical industry, the advantage of better non-corrosion properties is increased by the better physical properties of such alloys as compared with the pure metal, and although a particular alloy may be found satisfactory for several processes it need not be inferred that there is not one process for which that particular alloy is the only metal which can truly defy competition from any others. In some cases, of course, it may be a matter of view-point as to whether the copper in an alloy is the main feature or merely accessory to the corrosion-resisting properties. There are many copper-nickel alloys which are giving satisfactory service for pipes, valves, and corrosion-resisting castings, and which are well suited for salt waters, and in which the nickel content varies from 15 to 30 per cent. Advocates of the virtues of nickel may ascribe the quality of these alloys as being due to copper which is improved by the addition of nickel, rather than nickel which is finding better use by alloying with copper. An alloy composed of nickel 70 per cent. and copper 30 per cent., is well known to combine excellent mechanical properties with high corrosion resistance and freedom from contamination, and its broad use in the form of Monel metal for making stills, condensers, heat exchangers and other equipment might be equally well attributed to a modification of the nickel by copper as to improvement of the copper by addition of nickel.

Copper tubes are now being used in increased quantities for water supplies upon chemical plant, for oil supplies, oil vapours and compressed air. For water which has definite corrosive qualities red brass (85 per cent. copper and 15 per cent. zinc) is proving to be a satisfactory material; for the construction of condenser tubes the copper-nickel alloys are preferable. Evaporator parts, agitator paddles and shafts, and springs and bolts upon chemical plant generally are being made of bronzes containing silicon. The metallurgical features of these alloys may not particularly interest the user, but it may be noted as one example of progress that many brasses hitherto unsuitable for use due to dezincification are now being made usable by the addition of antimony to the alloy. Copper tube can be used for pipes carrying fuel gas if the sulphur content of the gas is low; in other cases there will be superficial sulphur attack, and the slight corrosive product which is formed can easily cause the clogging of valves or otherwise make valves difficult to operate. If the gas contains too much sulphur, tinned copper will prove to be more satisfactory than copper alone.

This tinned copper has been used extensively in the brewing industry for many years, but it has now been shown that so far as brewing liquors are concerned the original bare copper is actually much better than tinned copper. Copper has no adverse effect on either taste, odour or appearance of beer, as compared with the effects produced by other metals, but copper which has been hot tinned or electrically tinned has given adverse effects.

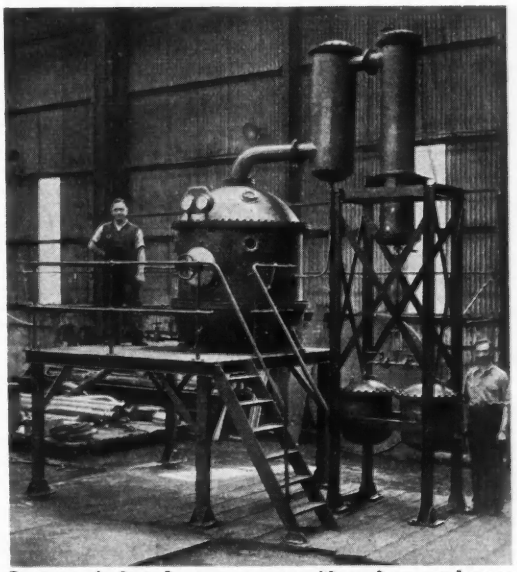
An increasing amount of silicon bronze is now being used for the making of chemical equipment where a variety of material is likely to be handled, and due to greater strength, better adaptability for welding and increased corrosion resistance there is no doubt that such uses will increase still further in the future. Indeed, it is probable that there are no other copper base alloys which show so good a combination of desirable properties as do these silicon bronzes. They make excellent castings with unusual strength, and have great resistance to fatigue and cracking under stress corrosion, as well as being highly resistant to a large number of chemical solutions. In addition, they are suitable for welding by all commercial methods, and this fact alone has done much towards gaining them a notice in fields of application which are diverse.

The matter of corrosion by sulphur, to which brief reference has already been made, comes to light especially in connection with the tubes of condensers and heat exchangers at oil refineries, where oil and vapour are in contact with one side of the metal wall of the tube and water is in contact with the other side. Investigations in this field have shown that any alloy with a high resistance to corrosion by water is vulnerable to attack by the sulphur in a mineral oil, and if sulphur corrosion is resisted then corrosion by water becomes a matter which demands attention. No single alloy appears to withstand both types of attack. High copper alloys show excellent resistance to the water in contrast with low copper alloys, and this is especially the case at temperature condi-

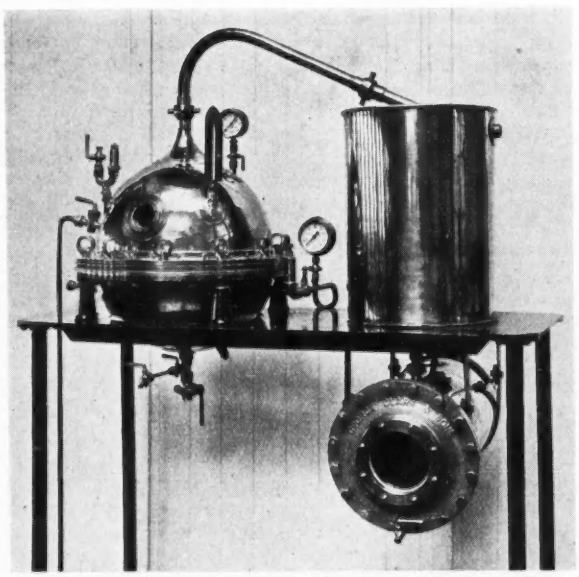
tions which obtain in practice at oil refineries. Low copper brasses, on the other hand, offer the best resistance towards sulphur corrosion, and the trouble has to be met by making composite tubing in which there is a commercial bronze for the water contact surface and brass for contact with the oil. In such a tubing, as now used in the United States and also in Germany, there is a very slight difference in the co-efficient of expansion by heat, and no particular problems are involved in the annealing and finishing of the tubes.

Tubes of deoxidised copper are now used in large quantities for heaters and evaporators. This copper is obtained by the deoxidation of electrolytic metal, containing a minimum of 99.9 per cent. copper, mainly by the addition of phosphorus, and the mechanical properties and thermal conductivity are not impaired. The impingent type of attack in condenser tubes is best met by use of an alloy of 92 per cent. copper, 4 per cent. nickel and 4 per cent. aluminium; this alloy also has unusual resistance towards attack by sulphur and therefore finds considerable application in condensers and heat exchangers for use at petroleum factories.

High copper alloys containing from 1 to 5 per cent. silicon and from 1 to 2 per cent. manganese, tin, or iron, have a notable feature in giving resistance to the action of hydrochloric acid, all strengths of the cold acid and hot acid up to 20 per cent. at 100° F. being handled satisfactorily in absence of air and steam. This group of alloys also proves to be satisfactory for hot dilute sulphuric acid, and for cold sulphuric acid up to 95 per cent. Copper-nickel alloys with 65 to 75 per cent. copper, 20 to 30 per cent. nickel, and 5 per cent. zinc possess a wide range of properties which can be varied by heat and mechanical treatment and they find good use in giving resistance to solutions containing salt or alkali, dilute chlorine for bleaching purposes, and dilute sulphuric acids. Aluminium bronzes give good service as a material of construction for pump parts, in equipment used for the pickling of metal by acid, and for pulping bars in the paper-making industry. These instances are mentioned merely to show that there is variety in the copper alloys and a change of possible uses comes about by slight modification of composition or treatment.



A steam jacketed vacuum pan with surface condenser and receivers for collecting the distillate constructed throughout in copper by S. Briggs and Co., Ltd.

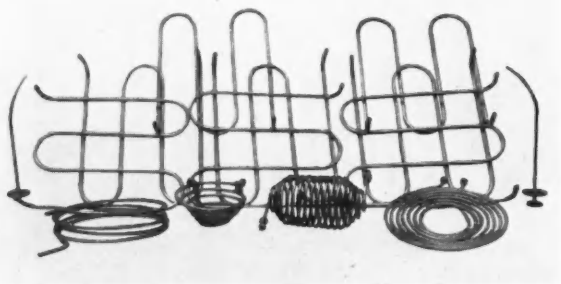


An essential oil still manufactured by George Clark and Sons (Hull) Ltd. It is designed for operating either under vacuum or at atmospheric pressure. The still is a complete unit and each part is separately detachable for thorough cleaning. The bottom half of the still is steam jacketed, fitted with pressure gauge, condensate drain, relief valve, etc.; the top half is fitted with a sight glass and an internal electric lamp. The vapour space has a thermometer, vacuum gauge, vacuum release cock, relief valve and syphon pipe fitted. The condenser consists of a tinned copper coil immersed in water and the receiver is mounted underneath the condenser with a large sight glass fitted.

In the fermentation industries copper is used extensively for the construction of brew kettles, fermenting vessels and equipment for yeast culture. Vessels with capacities exceeding 25,000 gallons are in use. Much of the inter-connecting pipework is also made of copper, including coils for cooling the wort. In some cases vessels are merely lined with copper, or have false bottoms made of either copper or bronze for straining purposes, as where wort is run from the mash tuns. Copper is also the usual material of construction for stills and distilling columns in the production of spirit, whether potable or for industrial uses. Here copper is used mainly on account of its corrosion-resisting qualities, high heat conductivity and ease of fabrication to difficult shapes such as that exemplified by a fire-heated whisky still. The re-distillation of methyl alcohol made from wood or by synthesis from hydrogen and carbon monoxide in the presence of a catalyst in a reaction vessel which is copper lined, is accomplished in copper columns.

Sugar refineries make wide use of copper or brass tubes in the juice heaters, heat exchangers and evaporators; vacuum pans for the more concentrated syrups are either made entirely of copper or fitted with copper coils. Copper alloys are also preferred for the screens and baskets of centrifugal machines used in separating the sugar crystals from the residual syrup. In the sugar refining industry there is also a notable use for heat exchangers made of copper or copper alloys, the quantities of water which have to be evaporated being large and demanding the most efficient rate of heat transference.

The pulp and paper industry provides several applications where copper meets with little competition from other metals. For instance both brass and bronze are employed for the large rolls which carry the woven wire belts on certain types of paper-making machines, and bronze rolls have been used to a considerable extent for pressing water from the paper before the latter passes to the drying machines. Wire cloth used in paper making is usually woven from phosphor bronze or brass wire, and similar wire cloth finds application in pulp thickening and pulp washing. Copper pipes and silicon bronze pipes up to 12 inches or more in diameter have been used for the handling of paper stock, an important feature of this application being that the toxic effect of copper upon micro-organisms is distinctly useful for preventing the accumulation of slime. In addition, both bronze and chromium-plated bronze has been used in the form of screen plates for



Various types of copper steam heating coils, used in pans and tanks in the chemical industry, made by William Brierley, Collier and Hartley, Ltd.

the fine screening of the paper stock, where facilities are again present for the accumulation of slime and troubles in this direction must be avoided. Machinery used for the refining of the pulp is preferably fitted with bars made of phosphor-bronze; nickel-aluminium-bronze and aluminium-bronze are preferred for the bars of the beating machines. Bronze of various types is used for pipework, valves and fittings upon the digestors used in the production of sulphite pulp, due to the good resistance which is offered against corrosion by the cooking acid and the relief gases.

Linseed oil boiling kettles and varnish kettles in the varnish-making industry are preferably made of copper, although other materials such as Monel metal, nickel and certain types of stainless steel have made some attempt to replace the metal. Almost invariably, however, where the body of the kettle may be made of some other metal, the base is copper or a copper alloy. Aluminium provides an alternative to copper for certain aspects of varnish making, being preferred where the colour of the varnish is a matter of special importance and copper does not appear to give varnish of the exact quality which is desired. Copper plant is used in varnish making mainly because it is necessary to adopt every precaution to prevent overheating and this needs the use of a metal which has high heat conductivity.

Miscellaneous groups of chemicals may be processed in equipment which is made wholly or partly of copper or high copper alloys, and reference in this connection can also be made to industries concerned with glue and gelatine, glucose, essential oils and perfumery. The manufacture of photographic chemicals and film emulsions provides an application for copper which is plated with silver; this material has also proved desirable for equipment used for the final treatment of lactic, formic, and acetic acids where a product of the highest purity is needed. Copper which is coated with tin finds good use in certain aspects of food processing, as in the case of fruit juices, vegetable extracts, conserves, dairy products and condensed milk manufactures.

Organic acids which may be handled in equipment made of copper or bronze include lactic, tannic, formic, tartaric, citric, oxalic, gallic, salicylic, phthalic, benzoic, stearic, palmitic, oleic and other fatty acids which are used in soap manufacture. There has been some outcry regarding possible contamination of soap with copper compounds, but this can be avoided by carefully selecting the particular alloy to be adopted for the equipment. The splitting and distillation of crude fatty acids is still done with the best possible success in equipment which is made of copper, and it is often found that the synthesis of certain classes of organic products on a semi-commercial scale can be carried out most profitably from the point of view of yield by using copper reaction vessels.

With copper and copper alloys generally the successful application of the metal to the making of equipment is attained by experiment with alloys which offer promise, using the actual conditions which will obtain in the process contemplated. To some extent the surface of copper and some of its alloys can act in a peculiar way towards retarding the formation of sub-products or the breaking down of others, giving rise to minor quantities of impurities which may affect quality. Both copper and high copper alloys are highly resistant to neutral and moderately acid or alkaline salt solutions, and tubes made of copper have been extensively used in evaporators for the production of crystals of common salt. Similarly, copper tubes have found preference in evaporators handling zinc chloride. Acetates, chlorides, nitrates, sulphates and oxalates have all been handled in copper equipment to one or other advantage, but there are, of course, instances where alternative materials of construction have decided points in favour of adoption. In all cases where it appears possible to use copper without disadvantage it will be found advisable to experiment with it in comparison with another material which appears to be equally suitable, because the copper equipment may provide evidence of some small advantage which is not always to be ignored.

The treatment of starch with small percentages of hydrochloric acid to effect the conversion of the starch into sugar, either dextrine, maltose or glucose as desired, is accomplished in corn starch converters which are constructed mainly of copper and bronze, silicon bronze being preferable for the resistance which is offered against corrosive action of the acid. The silicon bronzes are outstanding among the copper alloys which are useful in contact with hydrochloric acid. The resulting syrups from the conversion of starchy materials to sugar are generally concentrated in copper evaporators fitted with copper tubes and either copper or zinc-free bronze tube plates. Sometimes phosphor-bronze is used in place of copper for the glucose converters.

In the textile industries copper mixing pans equipped with bronze stirring gear are commonly used for preparing the colours for printing and dyeing, and engraved copper rollers are used in the actual process of textile printing.

Principal Characteristics of Copper

Their Utilisation in Particular Applications in the Gas Industry

PART of a paper on "Non-Ferrous Metals and the Gas Industry" presented by Dr. Harold Moore and Mr. E. A. G. Liddiard on Wednesday at the annual general meeting of the Institution of Gas Engineers dealt with the principal characteristics of the most important non-ferrous metals and the manner in which these characteristics are turned to account in particular applications in the gas industry. With regard to copper the authors stated:

Copper has good resistance to corrosion and is readily fabricated and jointed. These properties make copper pipe a particularly suitable material for gas distribution.

The movement towards the use of copper for gas distribution arises from the corrosion of cast iron or steel gas mains. This varies in intensity according to the nature of the soil in a particular area. For many soils copper immediately suggests itself as a less corrodible material. After various trials, installations totalling several hundred miles in length have been made in the United States. Very encouraging reports have come from the gas companies concerned; the life of the mains and services has increased and there has been a considerable reduction of renewal work. Suitable jointing devices are available, e.g., compression joints, etc. Copper pipe is more easily handled and worked than iron or steel pipe.

The cost of providing copper pipe, i.e., the price of pipe plus laying costs, is somewhat higher than for iron or steel,

but an overall saving is claimed owing to a reduction in upkeep and renewal charges.

A number of services ancillary to gas use considerable amounts of copper, in particular geysers and other water heaters. These have the water heating unit made of copper either as finned tubing or other construction to allow of a high rate of heat transfer, and the surrounding bodies are generally made from copper sheet. The heating tubes, bodies, and flues are "tinned" (varying proportions of lead being present) to protect the copper from the action of the sulphurous gases present in the combustion products. For such purposes the high thermal conductivity of copper, second only to that of silver, is an advantage.

Brass and Bronze

The solid solution of zinc in copper called alpha brass can contain up to about 38 per cent. of zinc at atmospheric temperatures. The alpha brasses have a degree of plasticity in cold working operations not attained by other alloys which are at the same time cheap enough and strong enough to serve as generally useful engineering materials of construction.

They are used for a great variety of articles, and all the established methods of working—rolling, drawing, pressing, stamping, spinning—are employed in making the intermediate and final products. Two of the compositions most commonly employed are 70 per cent. copper, 30 per cent. zinc (cartridge brass of 70/30 brass), and 63/37 brass. A group of brasses containing both the alpha and beta solid solutions is typically represented by the 60/40 mixture (Muntz metal). The feature which distinguishes these mixed alpha plus beta brasses from the simple alpha type is the high plasticity at red heat which disappears on cooling, i.e., these alloys can readily be worked hot by stamping, rolling, extrusion, etc., but are not suitable for severe cold-working operations, although they may be considerably strengthened by limited cold-working, e.g., drawing. This material is suitable for machining and the addition of a small amount of lead markedly improves free-cutting properties. Latterly investigations have been made on the use of additions of selenium, tellurium, or sulphur instead of lead, for conferring free cutting properties on copper and its alloys.

For special purposes, brasses are used containing additions of other elements to increase the strength or improve other properties.

In general, brasses are cheaper, stronger, and harder than copper, and have good casting properties. Brass is used in the cast or hot-pressed form for taps, injectors, tube connections, thermostat heads, governor bodies; as pressings or spinnings for burner orifices, air control washers, decorative fittings; as tube for thermostat couples and connecting pipes; as gauges for eddy filters and dust filters in thermostats and valve fittings generally; and in numerous meter parts, etc. Brass is readily jointed by soldering or brazing, and can be finished by nickel and chromium plating.

"Season-cracking" Trouble in Brass

Before its causes and means of prevention were understood, "season-cracking" was a not infrequent trouble in brass. It was liable to appear in cold-worked brass after a short or long period of use, sometimes several years, and to result in complete failure of the object. Season-cracking in brass has been shown to be due to the combined action of stress and of selective chemical attack localised at the crystal boundaries. As a rule the stress is internal, i.e., not caused by any applied force, and the attacking agent is ammonia, very slight traces of which in the atmosphere are sufficient to initiate cracking at the crystal boundaries if the surface of the brass is in tension.

The prevention or removal of the internal stress is a complete remedy. Internal stresses commonly arise in the course of cold-working, but manufacturing processes can usually be controlled to avoid the development of serious internal stresses in cold-working operations. There are certain operations, however, such as spinning and some kinds of drawing, in which it is difficult or impossible to prevent the development of high internal stresses, and the presence of such stresses can only be detected by destructive tests. If a brass article in a state of internal stress is heated for a short time at 250° to 300° C., the stresses are lowered to a safe limit and the danger of season-cracking removed, without any injury or loss of strength of the brass. Such "low-temperature heat-treatment" is frequently applied to brass articles in which the presence of internal stress and consequent liability to season-cracking are suspected, and is always an effective remedy.

Gas and its products of combustion appear to be capable of initiating season-cracking in stressed brass, and it is therefore important to ensure that brass articles and components used in connection with gas appliances are free from internal stress.

The copper-tin alloys (tin bronzes) are also of commercial importance. They contain commonly up to 10 or 12 per cent. of tin, and when phosphorus is used as a deoxidising agent in their production they are known as phosphor bronzes. They are of value in spring construction; thus the 10 per cent alloy cold-rolled or drawn to spring temper will withstand stresses in the neighbourhood of 40 tons per sq. in. without appreciable plastic deformation. Bronzes frequently contain additions of zinc, e.g., Admiralty gunmetal, which is copper/tin/zinc, 88/10/2.

The addition of tin to copper increases the tensile strength, hardness wear-resistance, and frictional-resistance. Phosphor bronze, gunmetal, and leaded bronzes contitute an important and valuable group of bearing metals.

The Copper Development Association

Steady Progress Reported

THE annual meeting of the Copper Development Association was held in London on Wednesday, the report and accounts being presented by the chairman of the council, Mr. D. Owen Evans, M.P.

Mr. Evans referred to the steady progress the Association had made and to the satisfactory position in which it had now become established as a central bureau of information for the copper industry.

The market price of copper during the past year had been relatively steady, he said, and a continuance of such stability would be of great benefit to industry and would assist development work. There could be no doubt that the many phases of the Association's activities had proved of great value both to the copper industry and to the users of that industry's products. The high standard of the technical books prepared and issued by the Association was widely recognised both in this country and overseas, and the demand for them had continued to increase.

The Associatio had been in existence for nearly six years, and the success which it had achieved suggested that it might become a permanent feature of the copper industry. It was satisfactory that its existence had been assured for at least another five years.

UNDER the name of the Anil Starch Products, Ltd., a company has been formed at Ahmedabad with a capital of Rs.25 lakhs. The managing agents are Kasturbhai Lalbhai and Co. and the object of the new company is to manufacture starches and other products from cereals such as maize, wheat, rice and from tubers such as potatoes, arrowroot, tapioca, etc., and also to manufacture glucose, dextrine and other products for edible purposes. The imports of starch and dextrine in India amounted to 14,000 tons in 1936-37 which shows there is a good demand; there are also abundant supplies of the necessary raw materials. The present plant of the company is designed to manufacture about 5,000 tons a year and will be located at Ahmedabad, orders having already been placed for machinery.

Personal Notes

BIRTHDAY HONOURS

The following are included in the Birthday Honours List issued on Wednesday night :—

Baronet :

MR. W. J. COURTAULD, J.P.

Knights Bachelor :

MR. A. C. MACLEAN, founder of the firm of Macleans, Ltd., manufacturing chemists.

Mr. W. Fraser, Knight.

Mr. A. C. Maclean, Knight.

Professor J. F. Thorpe, Knight.

MR. W. FRASER, C.B.E., deputy chairman of the Anglo-Iranian Oil Co., Ltd., and a director of other oil and petroleum companies.

DR. E. J. BUTLER, C.M.G., C.I.E., F.R.S., secretary to the Committee of the Privy Council for Agricultural Research and secretary to the Agricultural Research Council.

PROFESSOR J. G. KERR, F.R.S., J.P., M.P., member of Parliament for the Scottish Universities since 1935.

MR. C. E. BARTHOLOMEW, O.B.E., chairman and managing director of Bryant and May, Ltd., and of the British Match Corporation, Ltd. He entered the match industry in 1901 and was honorary secretary of the Match Control Board 1918-1919.

PROFESSOR J. F. THORPE, C.B.E., F.R.S., Emeritus Professor of Organic Chemistry at London University, past-president of the Chemical Society and of the Institute of Chemistry, and a member of the Chemical Defence Committee, War Office.

M.B.E. :

MR. A. F. MACCULLOCH, F.I.C., A.M.I.Chem.E., advisory chemist, Medical Store, Madras.

LORD CATTO has been elected a director of the International Nickel Co., of Canada, Ltd., in succession to the late Sir Robert Mond.

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SIR THOMAS HOLLAND has been awarded the Albert Medal for 1939 of the Royal Society of Arts for his services to the mineral industries.

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MR. CLAUDE H. WOOD, of Prescot, chief assistant chemist and senior metallurgist to Leyland Motors, Ltd., was married last week at Birkenhead, to Miss Freda May.

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MR. W. WEDGEWOOD, chemist and technical assistant, Newton-le-Willows Urban Council, has been appointed assistant engineer and manager to the Jersey Gas Company.

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PROFESSOR W. N. HAWORTH, Mason Professor of Chemistry in the University of Birmingham, received the honorary degree of Sc.D. of Cambridge University at Cambridge on Tuesday.

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SIR ROBERT HADFIELD, chairman of Hadfields, Ltd., and MR. HARRY BREARLEY, a director of Brown, Bayley's Steel Works, Ltd., received the freedom of the city of Sheffield on Tuesday.

Mr. G. F. Adams of the Research laboratories of The General Electric Company, Wembley, who has resigned to take up an appointment in September as technical sales representative in the London area for A. Gallenkamp & Co., Ltd. He will continue to act as hon. secretary for the London section of the Society of Glass Technology.

MR. WALTER DEACON was elected president of the Pharmaceutical Society of Great Britain, at a meeting of the Society on Wednesday. MR. F. G. WELLS was elected vice-president and MR. H. W. WALLIS, treasurer.

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MAJOR E. M. MURPHY, T.D., Royal Engineers, who is a member of E. Murphy & Co., manufacturing chemists of Liverpool, has been appointed Lieutenant-Colonel of the 8th Battalion of the King's Regiment, the newly-revised Irish battalion.

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MR. C. PATCHETT (Dorman, Long and Co., Ltd.), has been elected chairman of the Teeside Industrial Safety Committee. MR. WRAY, of I.C.I., Ltd., has been elected vice-chairman, and MR. R. J. WOODS, of I.C.I., Ltd., has been re-elected secretary.

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PROFESSOR J. W. MUNRO has been appointed by the Department of Scientific and Industrial Research to take charge of a new organisation which has been established to carry out research on problems of remedy and control of infestation of foodstuffs and other susceptible commodities in storage, processing, trading, and transport, and to provide an advisory service to industry.

OBITUARY

MR. HUGH BOYD, late chief engineer of the United Alkali Co., Ltd., Fleetwood Works, died on June 2, at the age of 67.

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MR. DAVID MACMILLAN, acting general manager of the Eclipse Works, Springburn, Glasgow, of Frederick Braby and Co., Ltd., structural engineers, died on June 2. Mr. Macmillan, who would have completed 60 years' service with the firm in January next year, took a prominent part in organising the recent centenary celebrations of the company.

Sir Percy Ashley, K.B.E., C.B., a member of the Import Duties Advisory Committee who was unanimously elected chairman of the British Standards Institution for the ensuing year at the recent meeting of the General Council of the Institution.

DR. A. S. RUSSELL, who was a chemist employed by the Imperial Tobacco Co., has left estate valued at £1,345.

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MR. WILLIAM CHARLES, governing director of Zenobia, Ltd., manufacturing perfumers, has left estate valued at £57,870 (net personalty £54,174).

General News—From Week to Week

ON THE RECOMMENDATION of the Import Duties Advisory Committee the Treasury has exempted from duty under the Import Duties Act, 1932, Rapidogen Navy Blue R.

THE GAS COMMITTEE of the Birmingham City Council has inaugurated an important scheme for the extension of the central chemical laboratory at the Corporation gasworks at Nechells at a cost of £36,143.

FIRE BROKE OUT at Warrington Corporation Gasworks on Monday. A large tar distillery plant, which includes two horizontal containers and a large reservoir full of solidifying tar, became ignited. The flames were extinguished by means of foam apparatus.

A FURTHER LARGE expansion in the form of a completely new machine shop is now almost completed at the Loughborough works of the Bush Electrical Engineering Co., Ltd. The company have been compelled to make this addition to deal with the large number of orders on hand, and to facilitate the production of other products which it may contemplate. The new machine shop will provide work for well over a hundred skilled men, trained to operate all types of modern machine tools.

AN ARRANGEMENT has been concluded whereby Johnson, Matthey and Co., Ltd., have acquired a controlling interest in Mallory Metallurgical Products, Ltd., and the offices of this company have been removed to those of Johnson, Matthey and Co., Ltd., 78, Hatton Garden, E.C.1. A new factory is being erected at Wembley for the production of the Mallory range of Elkonites and copper alloys for use as electrical contacts, switchgear components and resistance welding electrodes, and it is intended to develop the sales and service organisation in conjunction with Johnson, Matthey and Co., Ltd. Mr. S. S. Moore Ede and Mr. A. B. Coussmaker, directors of Johnson, Matthey and Co., Ltd., have joined the board of Mallory Metallurgical Products, Ltd., and Dr. L. B. Hunt continues to act as technical manager of the company.

KIRKPATRICK, BARR AND PATON, 4 Cullum Street, London, E.C.3, have been appointed sole concessionaires for the United Kingdom and Eire, of Farmaceutici Italia S.A. ("Montecatini Group"), Milan, manufacturers of mercury salts and other chemical and pharmaceutical products.

SCOTTISH DYES, LTD., Grangemouth, have had plans approved for extensions to cost over £4,000 to be carried out at their factory in Grangemouth. The extensions comprise four additional buildings—a decontamination centre, an office for the laboratory, a building to house the nitration plant, and an extension to a manufacturing shed.

RUGBY PORTLAND CEMENT CO. have entered into a contract for the purchase of the whole of the assets, undertakings and goodwill of the Gillingham Portland Cement Co., a private company owning a cement plant at Gillingham, Kent, with an annual capacity of 75,000 tons, deep-water wharves on the Medway, and 260 acres of freehold and clay reserves.

WORKERS employed at the factory of the British Aluminium Co., Ltd., at Lochaber, have decided to come out on strike unless their demands for increased wages and improved working conditions are granted within seven days. This decision was reached at a meeting of the workers held at Fort William last Saturday. The men's claims are for one shilling per shift extra for powermen and a 1d. per hour increase for other workers.

IN THE SERIES OF BRITISH STANDARDS for scientific glassware a further publication has now been issued relating to burettes and bulb burettes (B.S. 846). This specification furnishes detailed requirements for a range of burettes from 1 ml. to 100 ml. capacity, and for bulb burettes from 45 ml. to 105 ml. capacity. It contains particulars of the material to be used, of the dimensions and tolerances, as well as of the delivery time, jets, stopcocks and graduation marks. It also provides for the marking and testing of the burettes of which there are two grades. Copies may be obtained from the British Standards Institution, 28 Victoria Street, S.W.1 (Price 2s. 2d. post free).

A PLAQUE to the memory of Sir Eric Geddes, chairman of the Dunlop Rubber Co., Ltd., from 1922 to 1937, was unveiled at Fort Dunlop on Wednesday afternoon by Sir George Beharrell, present chairman of the company. The plaque is the gift of the Fort Dunlop employees.

FORTHCOMING EVENTS.—The annual meeting of the British Ceramic Society will be held at the North Staffordshire Technical College, Stoke-on-Trent, at 7 p.m. on Tuesday, June 13. On June 15 the annual luncheon of the British Standards Institution will be held at the Dorchester Hotel, W.1, following the annual meeting of the Institution. On the same day Mr. Kewley will address the Fuel Luncheon Club at the Connaught Rooms, W.C.2, at 1.10 p.m. on "New Aspects of the Petroleum Industry."

THE DANGER of the south-west area of Glasgow finding itself inadequately supplied with gas was emphasised by Mr. J. W. McLusky, Glasgow Corporation gas manager and engineer, when he gave evidence at a Board of Trade inquiry conducted by Mr. R. L. Sich, of London, at Glasgow, on June 1. The inquiry concerned the Special Order promoted by the Corporation for authority to purchase 4.1 acres of ground in Helen Street, Govan, on which it is proposed to erect an M.A.N. steel waterless gasholder to cost £130,000. The decision of the Board of Trade will be announced later.

THE KING AND QUEEN visited the famous Frood mine of the International Nickel Co. of Canada, at Sudbury, Ontario, on Monday afternoon. They decided to deviate from the rule announced when their tour of Canada and the United States began, that they would not visit any industrial concerns, so as not to miss one of Canada's most remarkable sights. After a tour of inspection their Majesties were given small samples of Frood ore as souvenirs. These are being preserved as companions to the specimens of local gold ore, which were presented on the previous day in an inscribed case at Sioux Lookout as a gift from the miners to Princess Elizabeth.

THE PROPOSED AMALGAMATION of William Baird and Co., Ltd., and the Scottish Iron and Steel Co., Ltd., is expected to be followed by a revival of the iron, steel, coal, and coke industries in Coatbridge. The proposed merger will make the new firm the richest concern in Scotland in terms of the raw material for iron and steel manufacture. The proposed company is to be known as Bairds and Scottish Steel Co., Ltd. The new move means the erection of the largest coke ovens in Scotland at the Gartsherrie furnaces of William Baird at an estimated cost of £500,000. This scheme has been held up for five years owing to the inability of Messrs. Baird to obtain an outlet for the surplus by-product gas from Glasgow Corporation and other local authorities. It is now planned to use the gas in the nearby iron and steel works of the combine.

THE LATEST FUEL RESEARCH SURVEY PAPER published by the Department of Scientific and Industrial Research gives the results of an exhaustive examination of another important seam in the West Yorkshire area and is the third report in this series of papers to deal with the seams in this part of the great coalfield of Yorkshire, Nottinghamshire and Derbyshire. The seam at present dealt with is the Barnsley or Warren House, and is the West Yorkshire equivalent of the Barnsley seam of South Yorkshire and the Top Hard of Nottinghamshire and Derbyshire. Under these various names it occupies a total area of at least 600 square miles and is one of the most important seams in the country. (The Barnsley-Warren House Seam. Fuel Research Survey Paper 46. (Published H.M. Stationery Office. 2s. net.)

Foreign News

MANUFACTURE OF CELLULOSE ACETATE PLASTICS (Acetolt) has been commenced at Kattowitz, Poland, by the Lignoza Company.

PRODUCTION OF GASMASKS, rubberised fabrics and other rubber goods is to be undertaken by the newly formed Nebojsa Company (capital 5 million din), a subsidiary of the Jugoslavian Bata Company.

ACCORDING TO A REPORT from the office of the American Commercial Attaché in Tokio, juice from the luffa sponge plant, which is produced in considerable quantities in Japan, is said to have medicinal properties, particularly in the treatment of respiratory diseases. It is cultivated in Japan mainly for the fibre which the fruit contains. The best grades are exported and listed in the trade returns as "snake gourds."

IN AN EXPERIMENTAL PLANT for utilisation of sewage sludge operated at Foggia by the Water Supply Corporation of Apulia, a yield of 43.9 litres of gas with a methane content of 82 per cent, and a heating value of 7,600 cal. per cubic metre was obtained from each kilogram of sludge in 40 days.

IT IS REPORTED from Japan that methylene chloride is now being marketed by the Saito Ryuso Seizojo, Osaka. The Osaka firm took up the manufacture of methylene chloride last spring and recently completed a plant to start commercial production; the present volume of production of about 10 tons monthly will probably be increased soon.

ACCORDING to the American Commercial Attaché at Copenhagen, the construction of a factory at Frederikshaven, Denmark, for the manufacture under a new Norwegian patent of a chemical phosphate fertiliser called "Orotosfat," is planned by a group backed by Norwegian and Danish capital. An annual production of 40,000 metric tons is proposed, natural gas being used for fuel.

PROVIDED IMPORTATION is effected not later than June 30, 1939, 4,500 metric tons of calcium cyanamide may be imported duty free into Italy according to a decree recently promulgated. During the period January 1 to February 25, 1939, the importation of calcium cyanamide into Italy amounted to 650 tons, a decrease of 6,147 tons compared with the corresponding period in 1938. The principal suppliers during the 1938 period were Switzerland and Yugoslavia.

THE SOCIETE FRANCAISE DES GLYCERINES has raised its capital by nearly 7 million francs with the object of building a factory for activated earths production at Marseilles. Activated earths have not previously been made in France and the company has undertaken a considerable amount of investigatory work on raw materials. The best natural earths for activation treatment have been obtained in the past from Germany; but it is now claimed that supplies of equal quality are now obtainable from an African source.

CONTRACTS have been issued by Battelle Memorial Institute, Columbus, Ohio, for the construction of a new research laboratory to cope with the expanding volume of industrial research. According to Mr. Clyde E. Williams, a director of the Institute, research expenditures by industry are growing by leaps and bounds, and the increased laboratory and office space at Battelle has been made necessary by the growing research activity in metallurgy, fuels, ceramics, and chemistry. The new construction will house chemical and metallurgical laboratories, photographic and metallographic departments, physics laboratories, and a large industrial laboratory.

IT IS REPORTED FROM INDIA that Mr. P. Roy has invented a new method of manufacturing sugar by which 90 per cent. of sugar can be extracted from the final cane molasses. His invention is said to be a modification of the well-known Battelle's process. He carried out his research work on a large scale in the Union Flacq Estate and also in the Reduit College of Mauritius. According to the sugar technologist of the Union Flacq Sugar Estate, the modifications that Mr. Roy suggests will undoubtedly give a new life to sugar factories, specially where the price of sugar is quite high and where there is no use for molasses.

Chemical Markets

TRADE in the general chemical market has followed a very even trend during the past week with no particular activity to record in any direction. Spot business is perhaps a little quieter than during the previous week, but contract deliveries are well up to schedule and quite satisfactory quantities are going forward for consumption. There are no important price changes to record for general chemicals, rubber chemicals and wood distillation products and values are well held. The recent improvement in the market for coal tar products has not been maintained during the past week, conditions being rather quiet due to a certain extent to seasonal influences. So far as values are concerned the position remain unchanged and quotations are steady.

MANCHESTER.—Price conditions have been generally steady on the Manchester chemical market during the past week and in few sections so far as the heavy chemicals are concerned is there much sign of easiness. Trading activity has recovered fairly well after the seasonably slow conditions a week ago and deliveries against contracts have been resumed in most directions, with the tendency in the textile dyeing and finishing trades towards a gradual improvement. The heavy coal-tar products are mostly in quiet demand and in some instances prices are not too strong, but the majority of the light materials are steady and in fair request.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

PRODUCTION OF WHITE OPAQUE ENAMELS, ETC.—Deutche Gold- und Silber-Scheideanstalt vorm. Roessler. (German, June 1, '38.) 15459.

MANUFACTURE OF ALIPHATIC ALDEHYDES, ETC.—Distillers Co., Ltd., and J. V. Eyre. 15303.

MANUFACTURE OF CELLULOSE DERIVATIVES.—H. Dreyfus. 15297.

MANUFACTURE OF DIMETHYLAMINE.—E. I. du Pont de Nemours and Co., and H. R. Arnold. 14884

MANUFACTURE OF BIURET.—E. I. du Pont de Nemours and Co. and J. Harmon. 15218.

Complete Specifications Open to Public Inspection

MANUFACTURE OF A GREASE COMPOSITION.—Standard Oil Development Co. Nov. 24, 1937. 23452/38.

TREATMENT OF SOYA BEANS.—W. J. Plews. Nov. 27, 1937. 24474/38.

DETINNING TINNED IRON.—P. Marth, and G. Sevenich. Nov. 29, 1937. 31373/38.

METHOD OF PRODUCING CATALYSTS.—Ruhrchemie, A.-G. Nov. 26, 1937. 3244/38.

MANUFACTURE OF NON-METALLIC RESISTANCE MATERIAL of substances caked or melted together in particular combinations of heavy metals and oxygen.—Ges. Zurwertung Chemischtechnischer Verfahren. Nov. 29, 1937. 33964/38.

PREPARATION OF WATER-SOLUBLE DOUBLE COMPOUNDS of purine derivatives.—Byk-Guddenwerke Chemische Fabrik, A.-G. Nov. 24, 1937. 34078/38.

PRODUCTION OF PHENOL-ALDEHYDE SYNTHETIC RESINS.—Bakelite, Ltd. Nov. 27, 1937. 34099/38.

PROCESS FOR THE MANUFACTURE OF WOOL DYESTUFFS of the anthraquinone series.—I. G. Farbenindustrie. Nov. 24, 1937. 34114/38.

AGENTS FOR ABSORBING CARBONIC ACID, particularly in gas-protection appliances.—O. H. Drager. Nov. 24, 1937. 34168/38.

MANUFACTURE OF CHLORINATED FATTY ACIDS.—I. G. Farbenindustrie. Nov. 25, 1937. 34182/38.

COATING OR IMPREGNATING SURFACES with polymerised 2-vinylfurane.—I. G. Farbenindustrie. Nov. 25, 1937. 34261/38.

PROCESS FOR THE MANUFACTURE OF CYCLOPENTANOPOLYHYDROPHENANTHRENE COMPOUNDS.—Schering, A.-G. Nov. 25, 1937. 34262/38.

MANUFACTURE OF ANDROSTENOLONES and derivatives thereof.—Schering, A.-G. Nov. 27, 1937. 34416/38.

PURIFICATION OF ZINC SULPHATE SOLUTIONS.—Montecatini Soc. Generale Per L'Industria, Mineraria, E. Chemica. Nov. 27, 1937. 34522/38.

DETERGENTS and the manufacture thereof.—J. Crosfield and Sons, Ltd. Nov. 27, 1937. 34572/38.

RECOVERY OF FATTY ACIDS and alkali salts from soaps.—I. G. Farbenindustrie. Nov. 27, 1937. 34590/38.

PLASTIC POLYMERS OF HALOGENOBUTADIENES.—E. I. du Pont de Nemours and Co. Nov. 27, 1937. 34655/38.

Specifications Accepted with Date of Application

MANUFACTURE OF DERIVATIVES of aryl substituted mono-olefines.—Distillers Co., Ltd., H. M. Stanley, and J. B. Dymock. July 19, 1938. 506,160

COLOUR-REPRODUCTION.—Interchemical Corporation. Sept. 4, 1936. 506,258.

REACTING CARBON MONOXIDE with hydrogen.—G. W. Johnson (I. G. Farbenindustrie.) Sept. 21, 1937. 506,064.

ELECTRODEPOSITION OF NICKEL.—H. R. Priston and G. E. Gardam. Sept. 23, 1937. 506,332.

COLOURATION OF MATERIALS made of or containing cellulose derivatives.—H. Dreyfus. Oct. 19, 1937. 506,163.

COLOURING OF CELLULOSE ESTER or ether materials.—H. Dreyfus. Nov. 20, 1937. 506,262.

SULPHONATED PRODUCTS and process of preparation.—Colgate-Palmolive-Peet Co. Dec. 21, 1936. 506,337.

TREATMENT OF SOLID CARBONACEOUS MATERIALS.—H. Quennell, and F. Lloyd. Nov. 25, 1937. 506,391.

MANUFACTURE OF RESINOUS CONDENSATION PRODUCTS.—W. W. Groves (I. G. Farbenindustrie.) Nov. 25, 1937. (Samples furnished.) 506,393.

MANUFACTURE OF OXAZINE DYESTUFFS.—W. W. Groves (I. G. Farbenindustrie.) Nov. 25, 1937. 506,349.

ELECTROLYSIS OF SALT SOLUTIONS.—I. G. Farbenindustrie. Dec. 31, 1936. 506,394.

MANUFACTURE AND PRODUCTION OF POLY-AZO DYESTUFFS.—G. W. Johnson (I. G. Farbenindustrie.) Nov. 25, 1937. 506,395.

METHOD OF MANUFACTURING LOW PHOSPHORUS STEEL.—L. S. E. Ellis (United States Steel Corporation.) Nov. 26, 1937. 506,403.

POLYSTYRENE COMPOSITIONS.—Distillers Co., Ltd., and H. M. Stanley. Dec. 24, 1937. 506,290.

PREPARATION OF ION-EXCHANGE and acid-removing materials.—Permutit Co., Ltd., E. L. Holmes, L. E. Holmes, and W. G. Prescott. Dec. 31, 1937. 506,291.

RECONDITIONING SOLVENTS used for dry cleaning.—L. H. Bergman, and H. G. Waite. Feb. 8, 1937. 506,078.

DYEING OF CELLULOSIC TEXTILE MATERIALS.—Courtaulds, Ltd., C. M. Whittaker, and C. C. Wilcock. Feb. 21, 1938. 506,203.

MANUFACTURE OF POTASSIUM PERSULPHATE.—B. Laporte, Ltd. March 31, 1937. 506,213.

Chemical and Allied Stocks and Shares

MARKET HOPES that the new Stock Exchange account would bring improved business in industrial and kindred securities have so far not been realised. Markets had a fairly steady appearance, although the recent sharp advance in prices led to a certain amount of profit-taking. Sentiment was not assisted very much by the lower unemployment figures and the steel production output announced for the past month, as they were in accordance with expectations.

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Although new "ex" the interim dividend, Fison Packard and Prentice ordinary shares continued to attract a good deal of attention, and on balance the price has moved up 1s. 3d. to 41s. 3d. Imperial Chemical ordinary at 31s. 9d., and the preference units at 31s. 4½d. were virtually the same as a week ago, while Borax Consolidated at 23s. 9d. were also little changed. Imperial Smelting at 11s. 6d. have lost a few pence of their recent rally, and B. Laporte remained around 56s. 3d. British Match at 33s. and Swedish Match at 26s. were unchanged on the week. The market is taking the view that there seem reasonable prospects of the latter company returning to the dividend list next year.

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Lever and Unilever at 37s. 9d. show a further rise of 1s. while, although "ex" the interim dividend, United Molasses were maintained around 26s. Turner and Newall were slightly higher at 81s. and British Aluminium were active around 58s. 3d., while British Oxygen at 81s. 3d. were within a few pence of the price ruling a week ago. Murex at 80s. were unchanged on balance. British Oil and Cake Mills preferred ordinary units again improved, and have moved up from 42s. 6d. to 43s. 3d. Reckitt and Sons' ordinary units, which had a more active appearance, moved up a further 1s. 3d. to 105s.

Movements in iron, steel and kindred securities were small but were mostly against holders. Consett Iron, Whitehead Iron and Stanton Iron were reactionary, although the results of the latter company were up to best market estimates and the dividend is again brought up to 10 per cent. despite the larger capital arising from last year's scrip bonus. Stewarts and Lloyds deferred were active and further improved from 45s. 6d. to 46s. 3d., it being pointed out that last year's 12½ per cent. dividend was a very conservative payment, as rather more than twice this rate was actually earned on the deferred units. Ruston and Hornsby remained under the influence of the past year's figures and were higher at 30s. 1½d., compared with 29s. a week ago. Tube Investments at 90s. 6d. were virtually unchanged. Guest Keen were lower following publication of the results but Dorman Long and United Steel had a fairly steady appearance.

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Associated Cement were better at 74s., compared with 73s. 1½d. and moderate gains were shown by various other cement shares. British Plaster Board were maintained around 29s. awaiting the results. Wall Paper Manufacturers deferred units at 27s. 6d. kept their recent rise, as did Pinchin Johnson at 25s. 1½d., while International Paint were 1s. 3d. higher at 81s. 3d. Cellon were higher at 15s. Barry and Staines remained at 35s.

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Boots Pure Drug were slightly lower at 42s. 9d., but are now xd. Sangers were again around 20s. 9d., and Timothy Whites and Taylors were maintained at 23s. 4½d. British Drug Houses were 21s. 3d., while William Blythe were 5s. 9d., and British Glues 4s. 9d. Monsanto Chemicals 5½ per cent. preference were again 21s. 10½d. Oil shares were reactionary in view of the cautious remarks at the Burmah Oil meeting.

COMPANY MEETING.

British Alkaloids Limited

Manufacturers of " T.C.P."

Further Expansion in Sales

The tenth annual general meeting of British Alkaloids, Ltd., was held on Thursday, June 1st, at Winchester House, E.C.

Sir Ivor Philipps, K.C.B., D.S.O. (the chairman), who presided, said that he would like to say a few words in memory of their late colleague, Mr. E. H. Parry. Mr. Parry had been actively connected with T.C.P. for over 23 years, and as early as 1916 his own faith in T.C.P. was such that he foresaw its unique value to humanity and determined to do all in his power to make its virtues known and its beneficial properties available to the public. He could say without fear of contradiction that Mr. Parry's faith in T.C.P. has been fully justified. They had indeed lost a very able colleague.

Turning to the financial side of their operations, the net profit for the year amounted to £62,132, which was £6,722 greater than a year ago. He was sure shareholders would agree that the progress shown was very satisfactory in view of the general unsettled conditions prevailing during the greater part of the year under review. The Board now recommended the payment of a final dividend of 18.71 per cent., less tax, on the preference capital, making a total of 26.71 per cent., less tax, for the year, and a final dividend of 33 per cent., less tax, on the ordinary capital, making a total of 45 per cent., less tax, for the year.

Sales showed an increase of 16 per cent. over those for the previous year, and taking into consideration the disturbed conditions prevailing during the greater part of the year, that result would, he believed, be received with general satisfaction. Once again he was able to report that the individual month's sales had shown an increase over the corresponding months in the previous year, and shareholders would be interested to know that sales for April and May of the current year showed a satisfactory increase.

Veterinary Field

That great importance was attached to the value of T.C.P. in the animal world was exemplified by the steadily increasing interest displayed in their product by veterinary surgeons, as well as by breeders and owners of domestic animals of all descriptions. The internal and external application of T.C.P. had proved particularly valuable for the prevention of distemper in dogs, and even in cases where T.C.P. had not been used until the disease had obtained a hold, speedy relief had been the result reported. The further valuable testimony and data they had received was much appreciated and was of considerable help to them in cases where their advice had been sought by the many animal lovers who consulted them from time to time.

As stated in the report, trade restrictions persisted in most foreign markets, due to unsettled world conditions. He could, however, assure them, as he had done in the past, that they were ready to take advantage of any opportunity of increasing their trade in those markets. In certain of the Dominions, sales continued to show an upward trend, and everything possible was being done to foster that important branch of their activities.

The chairman concluded with an expression of grateful appreciation to their marketing agents, to their factory and secretarial staffs and to their friends, the qualified retail pharmacists, all of whom had so largely contributed to the results obtained.

The report and accounts were unanimously adopted.

Company News

I. G. Farbenindustrie, A.-G., propose declaring a dividend of 8 per cent. for the year at the general meeting on June 23. The net profits were 55,180,000 marks.

Yorkshire Dyeware and Chemical Co., Ltd., have declared a final dividend of 5 per cent., making 10 per cent., less tax (same). A bonus has not been declared compared with one of 6¼ per cent. last year.

Triplex Safety Glass Co., Ltd., and Lancegaye Safety Glass (1934), Ltd., have reached an agreement for the acquisition by Triplex of the Lancegaye Co. The terms are: one fully-paid Triplex 10s. share for every thirteen Lancegaye 1s. shares.

British Oxygen Co., Ltd., have declared a dividend of 3¼ per cent., less tax, at 5s. in the £1, on 6½ per cent. cumulative preference stock and 2½ per cent., less tax at 5s. 4d. in the £, on 5 per cent. cumulative second preference stock, both for the half year ending June 30.

W. J. Bush and Co., Ltd., have declared a final dividend of 6 per cent., making 10 per cent., less tax (13 per cent.). A net profit of £54,271 (£116,265) is reported. Adding to this £114,562 brought forward and deducting amount required for dividends on preference shares and £23,490 provision for income tax and N.D.C., there remains a balance of £139,093.

Boots Pure Drug Co., Ltd., report that for the year ended March 31, trading profits, after allowing for staff pensions, tax, etc., are up from £940,332 to £951,010. Transfer from works development reserve and the addition of transfer fees bring the total to £957,198 (£949,474). Depreciation allowance is being raised from £81,350 to £92,441, while repairs, etc., absorb £81,965 (£98,998). After allowing for directors' fees, net profits work out at £776,293 (£762,626). Four quarterly interims of 6 per cent., less tax, have been distributed, and the directors are also paying a 5 per cent. tax free bonus, the same as for 1937-38.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the " Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

India.—The Director of Contracts, Army Headquarters, Simla, invites tenders for 630 tons zinc cake.

Forms of tender available from the Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1, at a fee of 5s., which will not be returned. Tenders must provide for delivery of the stores c.i.f. Calcutta and for payment in India in rupees. Any tender which does not comply with these conditions will not be considered.

Tenders must be cabled direct to the Director of Contracts, A.H.Q., Simla, to reach him not later than 1 p.m., Indian Standard Time, June 14, 1939.

His Majesty's Trade Commissioner at Calcutta reports that the Indian Stores Department is calling for tenders (Order Number M. 4464) for the supply and delivery as and when required during the year ending October 31, 1940, of quantities of chloride of lime.

Tenders should be addressed to the Chief Controller of Stores, Indian Stores Department, Miscellaneous Branch, Simla, by whom they will be received up to August 1, 1939. (Ref. T. 23434/39.)

Switzerland.—A well-established agent at Geneva wishes to obtain the representation, on a commission gasis, of United Kingdom manufacturers of pharmaceutical and chemical products, concentrated food essences for French Switzerland. (Ref. No. 441.)

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

A. G. TILLEY, LTD., Farnham, manufacturing chemists. (M., 10/6/39.) May 25, £1,400 debentures; general charge.

ADPREG, LTD., Newcastle-on-Tyne, glue manufacturers, etc. (M., 10/6/39.) May 22, £1,000 debenture, to Special Areas Reconstruction Association, Ltd.; general charge. *Nil. Dec. 31, 1938.

FITCHETTS, LTD., Birmingham, dry soap manufacturers. (M. 10/6/39.) May 23, mortgage, to National Provincial Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 28 and 30 Abbey Street, Hockley, Birmingham, etc. *£500. Jan. 12, 1939.